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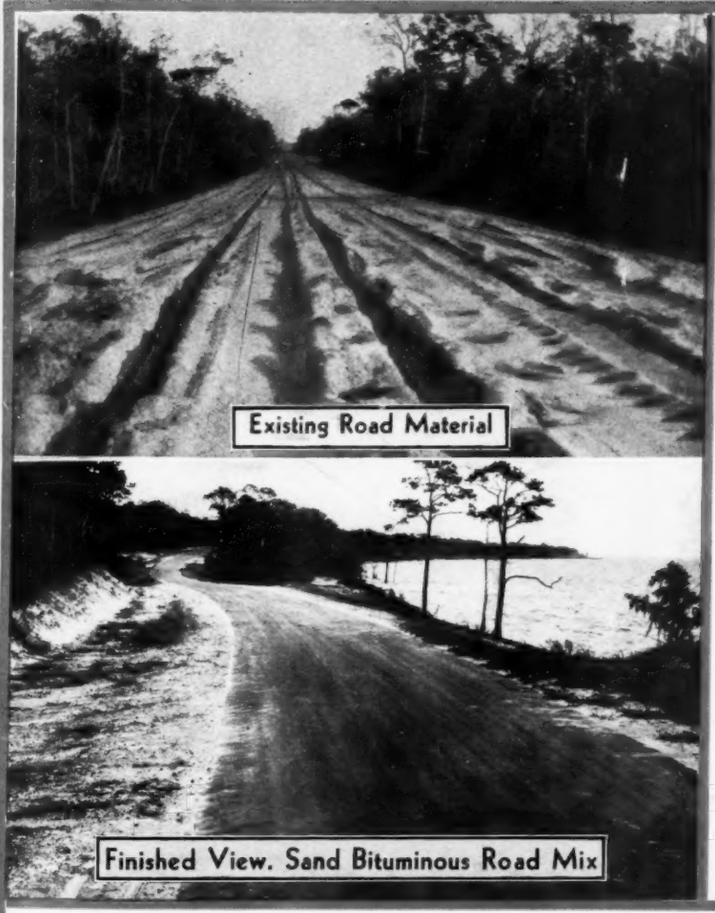
PUBLIC WORKS

City, County and State



Existing Road Material

Finished View. Sand Bituminous Road Mix

In This Issue

Inverted Shoulders on Highways
E. A. Burt

Night Visibility Tests on Highways
Moon and Warring

The First New York State Freeway
J. S. Bixby

Chemical Treatment of Sewage in Dallas
Steel and Zeller

Sewer Construction by Relief Labor
V. A. Rittgers

Flow Tests in Asbestos-Cement Pipe
E. K. Wilson

Comparative Cost and Efficiency of Coagulants

Coming in the Near Future

Sand Bituminous Road Mix Pavements in Florida ..... *H. C. Weathers*
Studies in Sewage Purification ..... *C. T. Butterfield*
Soil Investigations in Earth Dam Construction ..... *C. A. Hogentogler, Jr.*
Why Powdered Asphalt ..... *H. C. Offutt*
Ground Water Supplies ..... *Leland K. Wenzel*
Laying 13 Miles of Steel Mains ..... *C. M. Daily*
Water Supply for a Federal Homestead Project ..... *E. T. Roetman*

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APRIL, 1935

April 1935

PUBLIC WORKS

Vol. 66 No. 4

CITY, COUNTY AND STATE ENGINEERING AND CONSTRUCTION

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TIMEWASTERS

SOMETHING ELSE AGAIN:

— don't like - - said the man in the black - - -. The - - - - is more impressive when you - - - - - the body. You - - - - - - a - - - - - - - feeling of solemnity. There will be a - - - - - - - - against - - - - - - - - when the - - - - - - - - - - is realized.

The job, as elucidated by Bob Clark, is to fill in the above blanks, using in each blank all the letters used in the preceding blank. Thus "I" will fill the first blank, and perhaps "IT" the 2-letter second blank. The third blank will require three letters, two of which must be "I" and "T," if "IT" has been used in the second space.

A Catalog Problem:

A log 4 feet in diameter and 20 feet long is rolling down hill. A cat runs the length of the log while it is making one complete revolution. How far does the cat travel?

This Will Elevate You:

An elevator for use in a mine shaft has a 20-inch diameter drum which takes ten layers of 1-inch diameter cable when the car is in its topmost position. The drum is fitted with an automatic governor which maintains the rate of drum rotation constant during the descent of the car. At the beginning of the descent, the car travels at 5 feet per second. How fast is it dropping just before the cable runs out?

Some Answers:

There usually isn't space for solutions on this page, and we also usually haven't time to work all of them out in form for publishing a solution. But here are some answers. In the February issue, the tramp with three loaves of bread got 36 cents and the tramp with 2 loaves got 9 cents. Each tramp ate 1 2/3 loaves. The tramp without a loaf got 1/3 loaf from one man and 1 1/3 loaves from the other. The division will therefore be 4:1.

In the hunting problem, where x is the number of shots fired by Ikey, y the number of shots fired by Mikey, r the number killed by one and s the number killed by the other, there are a number of equations which we do not have room to publish. Complete solution will be sent on request for this and the courier problem. Ikey fired 24 shots and got 24 birds; Mikey fired 48 shots and also got 24 birds.

The courier reported on in the March issue, who started from the tail of the column to visit the head of the column traveled 13.2111026 miles, which wasn't nearly as bad as the job of telling the colonel why it took so long to make the trip. There are five equations to handle, which simmer down finally to

$$S = a + \sqrt{a^2 + b^2}$$

where s is the distance traveled, a the length of the column and b the distance it has advanced.

Another form of this problem, which is simpler for most people, but not for the TIMEWASTER editor is: A column one mile long, is moving at the rate of 2 miles an hour; a courier leaves the tail, traveling at the rate of 3 miles an hour; how far must he travel to reach the head of the column and then return to the tail? *W. A. H.*

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A. PRESCOTT FOLWELL, *Editor* **W. A. HARDENBERGH,** *Asso. Editor*

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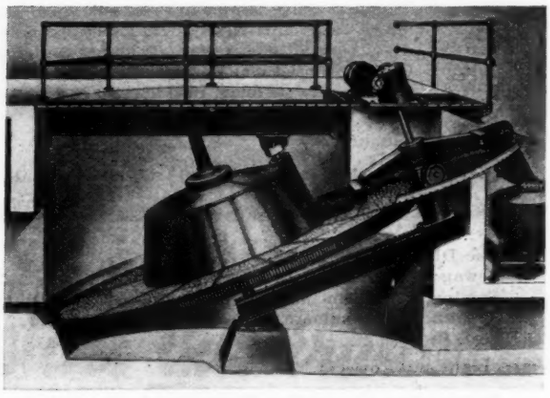

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PUBLIC WORKS

City, County and State Engineering and Construction

Vol. 66 *April, 1935* No. 4

Interesting Problems in Connecticut Highway Construction

By Cecil H. Trowbridge

Resident Engineer of Construction, Connecticut Highway Department

SEVERAL interesting problems in construction were developed in connection with an eight-mile highway extension in Litchfield County, Connecticut—from Cornwall bridge to the town of Sharon—a National Recovery project. The entire line was new location. The maximum grade was limited to 7%; minimum sight line to 500 feet; a minimum horizontal curve to 10° 46′; while cuts and fills (with 1:1½ slopes) were balanced. To meet these requirements necessitated cuts and fills up to 50 feet, with slopes running out as far as 150 feet.

Treating Slopes and Embankments

Except in rock cuts, 80 to 100% of the material excavated was light brown clay mixed with fine black and gray sand in a semi-fluid state. The bottoms as well as the sides of the cuts developed quantities of pressure water, up to 3-inch streams. This material, unless stabilized, slumps in sections as large as a small house in cuts, and sloughs down in embankments when wet. To prevent such slumping in cuts, they were widened 4 to 6 feet and in the width outside the designated shoulder line a ditch was cut with a 1:1 slope which was filled with boulders, excavated rock both large and small, stone fences, etc.; from which, as a base, a stone face or rip-rap was laid up the slope with its face on the designated face of the slope and carried up as far as any seepage occurred. This provided the three essentials of stabilization—bulk, weight and permanent porosity. The trench also tended permanently to lower the water table and carried the seepage water from the cut.

In fills this material, if kept dry, made a suitable embankment on which to construct a road bed. One embankment 30 feet deep and 600 feet long, which was thoroughly dried out but untreated, after a hard rain for 24 hours sloughed considerably; sloughed less the following day when it rained lightly; but the entire slopes were in continuous motion for the succeeding four days, when there was no rain but a dense fog, small portions sloughing and slipping down short distances. It was found that the saturated and sloughing material was but a few inches deep, the material under it being firm and dry; but when this was exposed by the sloughing it in turn became saturated and sloughed.

Treatment of the embankments consisted of applying to them a blanket 18 to 24 inches deep of the most non-porous material available—crusher-run material with screenings and 30% loam added, bank-run gravel with loam added, loam alone, or any material which would tend to shed water and keep the slopes dry. Care was taken when coming from a saturated cut to a fill to carry the cut seepage water away from the fill by means of deep lateral cut-off ditches backfilled with cobbles or other stone.

Where Forge Brook, a swift mountain stream, ran along the toe of a slope, this was rip-rapped. In a few side-hill cuts where embankment was to be placed on an original long, steep slope and the soil was saturated, the slope was covered heavily with ledge fragments before any earth fill was placed on it. This helped to hold the new fill in place, eliminating benching, and supplied ample, permanent and non-concentrated seepage and pressure drainage.

Building Concrete Culvert

Building a concrete arch culvert 24 feet diameter and 150 feet long involved only one real difficulty—handling the materials. The only available place for material delivery and storage was a level spot, reached by an old road, 110 feet above the culvert site and 75 feet horizontally from it. A high wire cable line stretched across the valley transported all fabricated and heavy material, while a wooden chute was used for the lighter material. All concrete was mixed in a six-bag paver and, by way of a chute (laid zig-zag to reduce velocity) was delivered to a central hopper, whence it was wheeled as desired.

This culvert is practically the same size as the Selby Hill street tunnel at St. Paul, Minnesota, and this tunnel's very fine centering design was followed. This is simple, strong and easily and quickly erected and taken down, with an extraordinarily high material salvage value. Native timbers were used for posts and bracings. The culvert was designed 26° 40′ skew on the road's center line. The forms, however, were built to a right section of the arch, thus eliminating angular cuts in timbers. One change only was made in the design; the tops of the footings were made a little wider on the inside to make seats for the sills.

Work had to stop during the almost unprecedented 30° below zero February weather, and during a 2-foot blizzard on February 19th; otherwise it proceeded uninterruptedly throughout the winter of '33 and '34. Work in wet, partly frozen clay in deep fills was possible only because of the mingled rock excavation which acted as foundation for the trucks and enabled the two bulldozers, always at work on each fill, to pull and haul the trucks about to their destinations and back again to the shovels.

Ultimately, this road will be paved. While the project is seasoning, settling and developing its weak places, the gravel subgrade will be surface treated; about one-half the distance having already received a second application of bituminous material. The remaining four miles will be surface treated this spring, just as soon as the extent of the '34-'35 winter ravages becomes apparent, the causes eliminated and the damage rectified.

Cost

The principal quantities and prices involved in this construction were as follows: Earth, 265,000 cu. yds. at 37.2 cts.; rock, 80,000 cu. yds. at $1.00; gravel stabilization of subgrade and shoulders, 83,000 cu. yds. at $1.09; class A concrete, 1,232 cu. yds. at $9.06, and class B concrete, 2,500 cu. yd. at $6.60. All humus was taken out full depth and width at earth excavation price and windrowed neatly outside construction lines for future use by the Roadside Development section, as was loam from cuts and fills; the humus pits, 10 to 12 ft. deep, being backfilled with rock and other suitable material.

Rebuilding a Forty-Year-Old Brick Pavement

By F. G. Blue
City Engineer, Defiance, Ohio

FORTY years ago Clinton St., our main street, was paved with brick, on a macadam base for the most part. A grout filler was used on 11,500 square yards, and asphalt filler on 24,500 square yards. Under the wear and tear of traffic for four decades, this street became very rough, though the brick were still in good condition. This pavement was rebuilt in 1934.

About half of the work was done under the CWA at a wage scale of 50 cents an hour, and the remainder under the FERA at a wage scale of 30 cents an hour. The city furnished all material except new brick, which was furnished by the State Highway Department. The entire cost to the city was about $15,000, which included stone for repairing the base, the new sand cushion, asphalt filler, truck hire, etc.

The cost of labor for repairing the base, the new cushion, laying the brick, applying the filler, and removing the old brick, where all new brick was used amounted to 50 cents a square yard. As a matter of policy, new brick were used through the business section, which was about 35% of the total yardage, though there remained enough usable old brick to reduce this to about 25% of the total.

The cost of labor, repairing the base, the new cushion, taking up, cleaning and relaying old brick, and applying the filler, where all old brick were used cost $1.00 per square yard.

We found that by handling old brick, especially where a tar or asphalt filler was used in the original construction, loading into a truck and dumping about twice, the bricks were cleaned sufficiently to use; and when cleaned this way they make a better job than if too well cleaned. A great many of the old brick are without lugs or separators and if hand cleaned they lie too close together to receive the proper amount of filler; and this is especially true unless the laying is done by an experienced man.

Missouri Doubled 1925 Tax Collections Last Year

State gasoline tax collections for 1934 set an all-time record in Missouri last year, Roy H. Cherry, State Inspector, reports. Total collections for the year were $9,788,019, almost double the amount collected in 1925, although the tax rate has remained the same, 2c per gallon.

Collections in 1934 exceeded those of 1933 by $434.-000. During the ten years that the state has collected a 2e per gallon tax on gasoline, this levy has produced $79,036,410.

Development of a Surface Water Supply

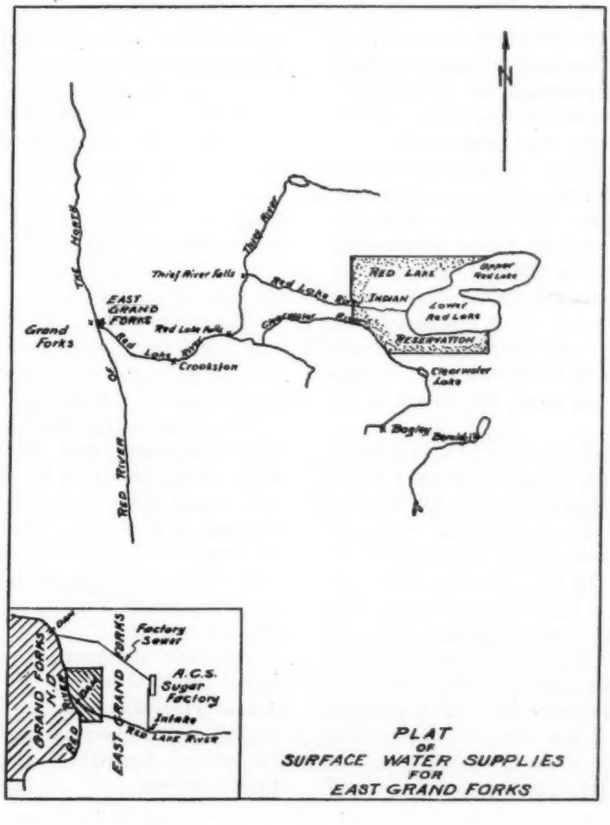
By E. L. Lium
City Engineer of Grand Forks, N. D.

THE city of East Grand Forks, Minnesota, located in Polk county at the intersection of the Red Lake River with the Red River of the North, has experienced during the past drought years a great deal of difficulty in maintaining a surface water supply from the standpoint of both quantity and quality. These difficulties have been met and overcome jointly with the cooperation of other cities on the Red Lake River and the city of Grand Forks, North Dakota, located directly across the Red River of the North.

East Grand Forks in 1908 constructed a city filtration plant which includes an intake system from the Red Lake River, sedimentation basins, rapid sand filters and clear well storage. This plant has a capacity (filtration rate) of 1,500,000 gpd. The population of the city is 3,000. The water consumption averages about 300,000 gallons per day during summer months and about 200,000 gallons per day during the winter. The Red Lake River from the beginning of its use as a source of supply furnished a very satisfactory grade of raw water for a plant of this type. The flow was plentiful and the quality was such that it was not at all difficult to produce a very satisfactory finished product. During the winter months it would have been possible to supply a satisfactory product merely by pumping to a settling chamber, chlorinating, and then pumping to the distribution system.

In 1910 the citizens of Grand Forks and East Grand Forks first became alarmed over the low water conditions of the Red Lake River. In the fall of 1910 they constructed a small rock dam across the Red Lake River below the intake pipes of the two cities in order to make sure that the supply would not freeze solid during the winter months. Water levels in the Red and Red Lake Rivers continued to fluctuate greatly, with the result that during certain periods of the summer months local conditions became bad due to the exposed ends of the local sanitary sewers. As a remedy for this condition, and also to beautify the river, prevent slipping of river banks, and afford recreation facilities, a dam was constructed across the Red River of the North, below both cities and below the junction of the Red Lake River with the Red River of the North. Directly after the construction of this dam across the Red River of the North the American Beet Sugar Company located their plant adjacent to the city of East Grand Forks and placed their intake in the Red Lake River above the intakes of the two cities. The wastes from the American Beet Sugar Company's plant were discharged approximately 1,000 feet above the dam across the Red River of the North below the two cities. The water demand of the American Beet Sugar plant during operation was between five and six million gallons per day and the demand of the two cities together was about 1.6 million gallons per day.

In 1931 it became apparent to the officials of East Grand Forks that their water supply was fast diminishing and that, in order to take care of local industries as well as the city's needs, it was necessary to begin some kind of a conservation program. The impounding reservoir caused by the dam below the cities extended for miles up the Red River of the North and the Red Lake River, and it became apparent that wind action on this pond in some instances produced a current in an upstream direction which made the waters at the intake very unsatisfactory. In the month of October, 1932, due to the heavy water consumption of the American Beet Sugar Company taken above the municipal intakes, and the dumpage of their wastes above the dam, together with an inch of rainfall in the immediate vicinity, the movement upstream produced was so great that the waters at the municipal intakes became very highly polluted with organic substances and bacteria due to the sugar beet wastes and sewage carried upstream in the impounded waters. The bacteria counts per cubic centimeter exceeded one million and the colon



bacilli per cubic centimeter amounted to several hundred thousand. This condition, together with the fact that other cities on the Red Lake River were experiencing low water and in fear of losing their entire supply, led to the establishment of a water conservation association including the various cities on the Red Lake River, and this association appealed to the Federal Administration with the assistance of the Minnesota Department of Conservation for a program whereby the flood waters of Red Lake might be controlled and utilized during the dry months of the year. This program failed to meet with necessary approval due to the fact that too many legal obstacles had to be overcome in order to secure right of way and permission to construct the necessary dams and ditches on the Indian Reservation at Red Lake.

It was necessary to find a remedy in some other manner, and to find continued water supply from some source other than that of Red Lake. The only other possible source that could be used was that of Clear Water Lake, a very small lake compared to Red Lake and heretofore regarded as of no consequence from the standpoint of water supply. However, it was found on investigation that the waters of Clear Water Lake had maintained a constant level for a great many years and that they had not been much affected by the drought condition of the past few years. It was also found that the flow from Clear Water Lake was very constant during the greater portion of the year and that it was always ample to take care of the needs of the cities' water supply. A dam across the Clear Water River where it leaves Clear Water Lake, constructed by the State Game and Fish Department, serves to hold a constant head in the lake, and it became apparent to the cities along the river that if they could utilize the water impounded in the upper one foot depth of the lake, they might be able to maintain their water supplies in a satisfactory manner from the standpoint of both quality and quantity. Through the cooperation of the Minnesota State Board of Health and the Minnesota Department of Water Conservation and Game and Fish Department, the cities dependent on Clear Water Lake in 1934 secured permission to draw the lake water down one foot below normal during the winter months, and during the past winter this method has proven itself to be very satisfactory. All of the cities have had sufficient water and its quality has been considerably better than it has for several years past.

The local situation with regard to the back-flow of local wastes to the intake waters was corrected during the past year by the construction of a dam on the Red Lake River above all of the local sewers but below the waterworks intakes. The dam impounds a reservoir with a head 4 feet higher than that of the dam below the cities. This new impounding reservoir not only prevents the back-flow of polluted water but also maintains a supply sufficient to tide the city over several months of no flow in the river. With this new impounding reservoir and privilege to draw one foot of impounded water from the surface of Clear Water Lake, the city's water supply has been developed to the extent that the city is assured of an impounded supply of water that can be successfully treated so long as drought conditions do not further diminish the source of supply.

Recent Highway Work in Germany

RECENT highway work in Germany has consisted chiefly of adapting to modern automobile traffic the already existing roads; although the construction of several thousand miles of express highways, which has been begun, is now the most important work.

In improving old roads, a thin bituminous surface course placed over a well compacted macadam road generally gives excellent results. Penetration methods, emulsions, and (for city streets) sheet asphalt are used extensively. Bituminous surfaces cost three or four times as much as in the United States, these surfaces are usually thin, in some instances only about one inch thick.

Almost without exception, all existing roads are lined with trees. Roughly split rocks, about 16 inches high and painted white, are set along the edges of the shoulders for guidance.

The first unit of the proposed system of express highways (autobahnen), consisting of approximately 5,000 miles, is now under construction and about 1,000 miles have been completed. Hand labor is employed whenever feasible for the purpose of decreasing unemployment.

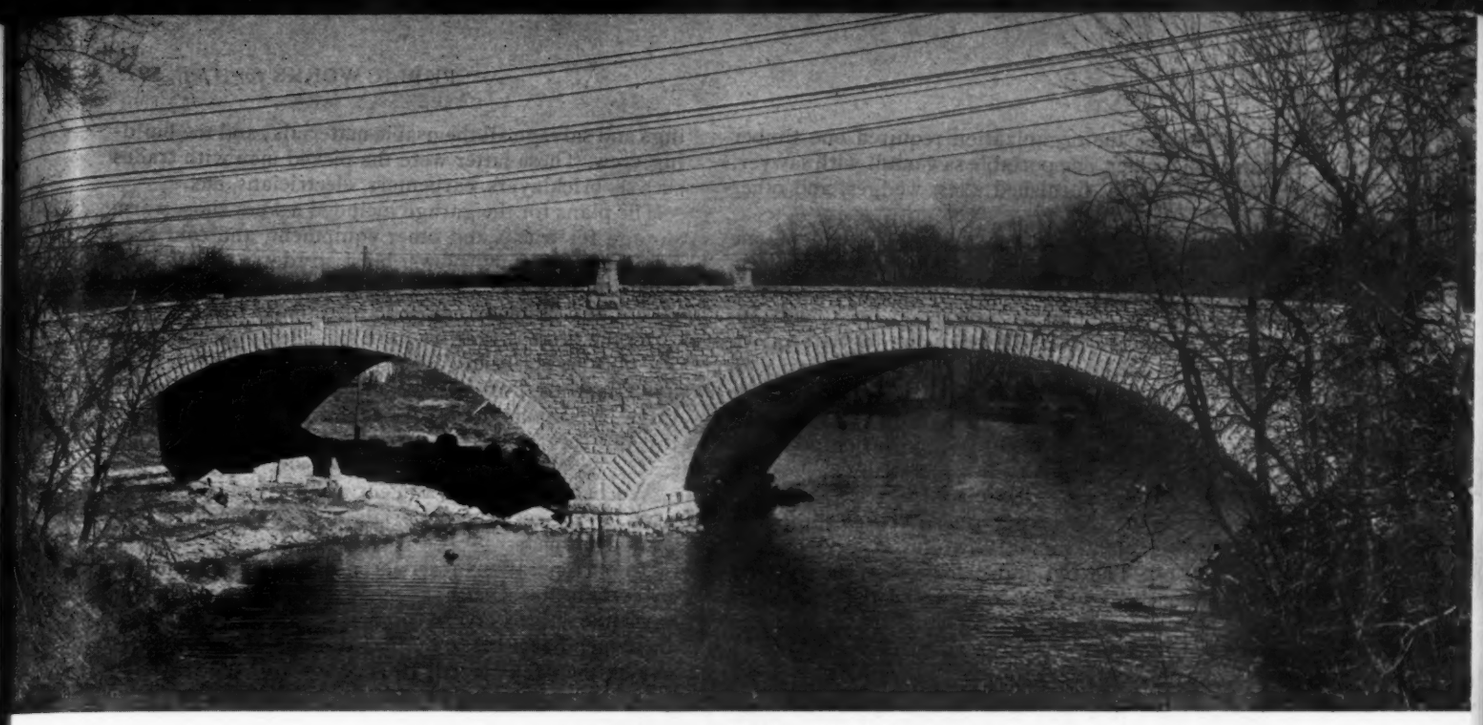
The roads are being built for high speeds, curves being designed for speeds up to 120 miles per hour. The typical cross-section comprises a center parking strip 15 feet wide, on each side of which is a pavement 25 feet wide for two traffic lanes in the same direction, bordered by shoulders. Trees and shrubbery are being planted in the center strip, species being selected that reflect automobile headlights readily; one purpose of which is to protect drivers from the glaring headlights of approaching cars. Similar trees and shrubbery are planted along the edges of the shoulders also.

The pavements on these express highways are either bituminous or Portland cement concrete. Great care is taken with the construction of the highway to prevent damage from frost action. A concrete pavement consists of approximately 3 to 4 inches of gravel spread on the subgrade, 5 inches of rather porous lean concrete, a 6-inch course of a little better grade of concrete, followed by a 3-inch surface course, with a wire mesh between the last two courses.

The bituminous surfaces are constructed either on a lean Portland cement concrete base or on a telford base, and are designed according to the void theory, attempting to produce a minimum of voids (2% to 4%).

The express highways will be absolutely free from grade crossings and intersections, viaducts or subways being provided to permit a continuous fast and safe travel. Elaborate systems are worked out for the crossing of highways (braided intersections) to permit the transfer of a machine from one highway to another. The roads will also be illuminated, and experiments are being carried on at present with five different systems of lighting.

The above information was furnished by Ernest Zube, junior physical testing engineer of the California Division of Highways, having been obtained last year during his visit to Germany and contained in an article in the official journal of the California Department of Public Works.



Stone bridge over Cedar River at Austin, Wis., built with CWA labor

Federal Participation in Local Projects: CWA—PWA—ERA

By A. C. White

Highway Engineer, Mower County, Minn.

OUR policy has been to co-operate with the Government in all its endeavors to bring about recovery. In Mower County we have had as our standards: That projects be of a permanent nature; employ a maximum of labor; be of a nature that they otherwise would be done with local funds if these were available; be economically sound; use as much local materials and resources as possible; educate and better fit the individual to earn a living; use a diversified classification of labor; and harmonize with plans for future projects.

With these items in mind a hasty survey was made when the CWA was started. Two natural resources available were oak timber and deposits of dolomite limestone. Work was started immediately, stripping and quarrying rock, and logging. The shale overburden above the ledge rock, we decided to crush for macadam roads and the ledge rock to use for dimension stone for a bridge and dam. The lumber was to be used for falsework for the bridge, and also for the construction of small pile and timber bridges.

In determining the location for the stone bridge we considered it as a necessary replacement structure on a permanent location, which was petitioned for, a public project, and one where plans and surveys had been started.

The River Street bridge over the Cedar River on one of the main streets in Austin was selected. The structure in place was a 160-ft. wrought iron, high pin connected truss on masonry abutments, 16-ft. roadway, built in 1884. It had been condemned for loads exceeding 5½ tons.

After a study of the bridge site and of the quality of stone, a double-span 80-ft. stone arch with 30-ft. roadway and two 5-ft. sidewalks was decided on, and plans were immediately started for this type of structure. Simultaneously, 9 small-span bridges were selected to be built as creosote-oil-pressure-treated timber and pile bridges. These bridges were from 16 to 90 feet in length with standard spans of 12 feet and 16 feet.

The timber selected, covering 33 acres, was mostly red and black oak. Trees varied in thickness from 8 to 22 inches. A sawyer was secured at $7.50 per M, and the material was sawed into 2x4, 2x6, 2x8, 3x12, 3x10, 4x6, 6x10, 10x10 and lengths from 8 feet up to 16 feet.

Organization of Crews

The County hired its own foreman and the CWA furnished the other clerical help. At the quarry where the most men were employed, there were two crews. In one, the organization consisted of quarry foreman, straw boss, two powder men and 10 laborers. This crew got out dimension stone of sizes as sent to them by the stone draftsman at the bridge site. Their equipment included 3 air hammers and drills using one 220-cubic-foot air compressor, one 25-h.p. 3-spool steam hoist, and a 65-foot derrick. The other quarry crew consisted of a labor foreman, two straw bosses, two powder men and approximately 125 laborers. The equipment consisted of one 15x36 rock crusher, bucket conveyor, 4-compartment rotary screen and bin, 60 h.p. power unit and the use of the derrick. Their duties included the removal of overburden and feeding of all rock above the ledges into the crusher.

In the woods, the organization required one timber foreman, one scaler, one portable saw outfit with sawyer, and 80 men. CWA furnished axes, wedges, and other equipment.

At the bridge site, there were one superintendent, one foreman, one straw boss, one chief stone cutter, one stone draftsman, and about fifty men. The equipment consisted of one 25-h.p. 3-spool steam hoist with 70-foot derrick; one 40-foot stiff leg, using 30 Caterpillar, with single spool hoist; one 110-foot compressor, with air tools for stone cutting; and one 18-inch portable electric saw.

Our timber and pile bridge organization consisted of a foreman and 10 men equipped with one ½-yard drag line with leads for driving piles.

As soon as the timber was sawed it was shipped to the creosoting plant for a 10-lb. initial air treatment of creosote oil. The red and black oak takes an excellent treatment and we were very well satisfied with the results as shown by the boring and the amount and depth of penetration.

What PWA Covered

Before the CWA had well started, we made application for a $33,500 Federal-Aid Grant for 25 miles of grading and gravel surfacing, and 30 miles of bituminous treatment using the road-mix type (later we used the machine-mix type). The plans contemplated a 1½ inch mat, 20 feet wide with penetration shoulders, using for prime 0.2 gallon of 70-80 road oil and 0.5 gallon of cut-back asphalt on 15 miles; and 0.2 TC1 tar for prime and 0.5 gallon per sq. yd., TC3 tar for mat coat on 10 miles.

This in general constituted the PWA work done by the County. The work in detail will be taken up in subsequent articles describing methods of construction and materials used.

Working Under the ERA

Located just outside of Austin were land, buildings, and kilns of a brick and tile company which had failed. The county acquired this property by tax lien, and sold a part of it, but retained the buildings, 12 brick kilns and 4½ acres of land.

Since the county was renting a building for garage purposes, it was decided to rehabilitate the brick yard buildings for a garage. The project consisted of razing the brick kilns and part of the buildings, and salvaging materials for the construction of other buildings, using ERA labor.

The organization was composed of two groups: the wrecking crew, whose duties were to wreck the buildings and salvage all the usable materials; and the building crew. These latter were the picked men with trades such as bricklayers, carpenters, electricians, etc.

The plans for the garage included a work shop, warm storage for trucks and other equipment, and cold storage room for snow plows, hoist graders, mixers, and pumps not in use. The buildings are of such size that all of our equipment can be housed under cover.

At the present time we have salvaged approximately 300,000 usable brick; 5,000 4x8x12″ hollow tile; and miscellaneous T-irons, I-beams, channels, and pipe fittings. Approximately 80 men have been working on this project.

Reactions on Work Relief

We believe the government should furnish at least part of the costs of materials and equipment on approved projects.

In our operations it has been necessary to train men in certain lines, such as stone cutters, stone masons, carpenters, bricklayers, pipe layers, etc. The use of these men has necessarily placed union men with trades among the unemployed. It has been our experience that more non-relief help should be allowed on ERA projects.

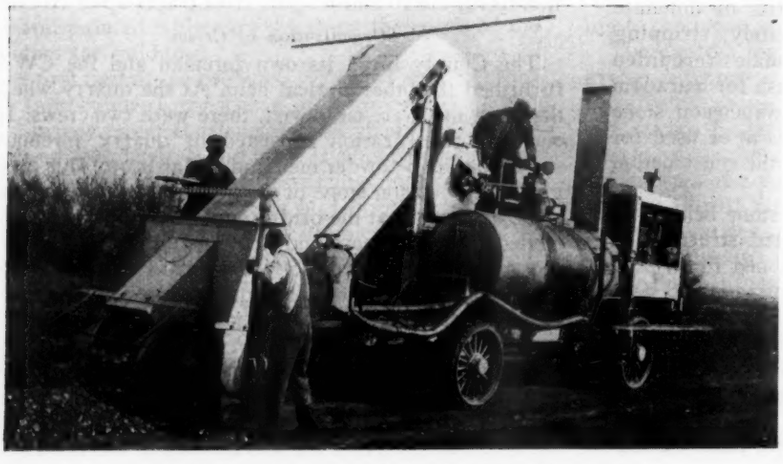
We believe in the use of the prevailing wage scales of the locality where the work is being done. In this community the laborers are more interested in their weekly wage than they are in their hourly rate. Industry in this locality is set by code from 42 to 48 hours per week; non-code employees 60 hours per week; state employees 30 hours; city 48 hours; county 48 to 60 hours; PWA 30 hours and ERA 30 hours.

On our PWA work the men were housed out on the job which necessitated their paying board and room away from home on all time over the 30 hours. Had this item been under the control of the local committee, it would have been possible to have the men work one week and lay off one week. On this class of work which is seasonal in character, a laborer should be able to earn enough in the summer to keep him in winter. Many of the men who were employed on PWA work during the summer are on relief this winter. It seems that the weekly hours of work and the wage scales should be determined by the local committee.

In this community, industry is paying a 47¼c minimum hourly rate; the city 40c; the county 35c; the state 50c; and ERA and PWA each 55c. Local private wage scales are from 25c to 35c. The opposition among the public is strong against the 55c rate. It is my opinion that relief labor should be paid 40c per hour minimum, with a 45-hour week.

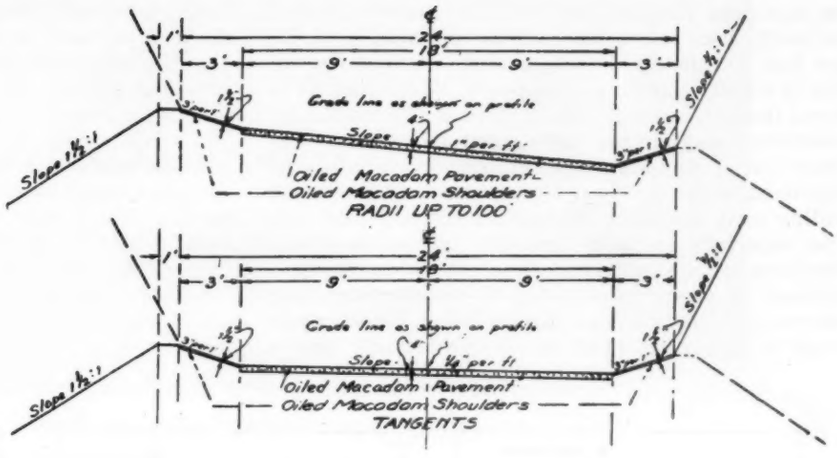
It seems from our experience in working under all these agencies, that the PWA was the most effective unemployment and relief method. The federal grant could be increased up to about 60% of the cost of the work, with local funds for the 40%. This would gain for the local community much needed improvements which they cannot otherwise afford if they must buy all the materials and the equipment, and would place labor in an excellent position.

In succeeding articles Mr. White will describe the details of Mower County construction projects. Comments on the policies outlined in this article are invited by Mr. White and the Editor.



Mixing machine used on Mower County road projects

Inverted Shoulders Solve Drainage Problems



Standard cross sections for Los Angeles County roads

By E. A. Burt

Construction Engineer, Los Angeles County Road Department

DRAINAGE problems and erosion control on county roads often present a particularly difficult situation, due primarily to the limited funds available for correcting this type of difficulty. The Los Angeles County (California) Road Department has devised a method of solving this problem, which is, in effect a substitute for concrete or rock curbs and which has been designated as "inverted shoulders."

In most cases the handling of drainage along the roadside can be arranged successfully by the use of concrete curbing, but there are many in which the cost of this type of construction is prohibitive. In addition to the matter of cost, it is the policy of many highway organizations to require adjacent property owners to provide structures of this nature. It was these two features particularly which played an important part in forcing the development and extensive use of the inverted shoulder.

As the name implies, this type of shoulder slopes up from the edge of pavement or flow line rather than down, thereby retaining drainage water in a defined course which can be diverted at short intervals into channels carrying the water away from the paved area. The most success can of course be obtained where the shoulder is given some type of bituminous treatment; in fact, the extensive use of this plan without some surface treatment is not recommended. In view of the widespread use of surfaced shoulders on present-day construction there is no appreciable increase in cost for this treatment.

This type of storm water control has been used in practically every topographical and soil condition in the county, ranging from steep mountainous territory to the flat coastal plain. On mountain road construction there are several distinct advantages obtained. The actual width graded can be more fully utilized for traffic, thereby in many cases saving two or three feet of the most expensive grading cost. There are no gullies washed along the inside of cuts for wheels to drop into or force traffic too much onto the wrong side of the road. The slightly rising shoulder on the outside of cuts improves the feeling of safety of those using the road. Where slides occur and drainage water is forced from the inside to the outside of the road, the outer shoulder prevents overflow down the side of fills and the flow after a short distance is diverted back to its proper position. In some cases where vehicles pass each other only occasionally, the actual width of paving can be reduced to 10 or 12 feet, which, plus 3-foot shoulders, gives adequate width for passing. In the flatter farming country the convenience of ingress and egress to property is especially desirable, in addition to the fact that interference with flow at driveways is eliminated. Also in this kind of territory where standing water often occurs and in many cases softens and deteriorates subgrade under edge of pavement, the inverted shoulder is very desirable as it tends very much to eliminate this tendency.

In designing this type of shoulder there are a variety of standards which can be used, depending on

the particular situation involved. The narrowest width ordinarily used is two feet and the minimum slope 2″ per foot. On the other hand, a width of five to seven feet is not uncommon, with slopes of 3″ per foot. It is found that this latter amount of slope is a maximum for convenient longitudinal rolling, but in extreme cases where large volumes of water are occasionally encountered, slopes of 6″ per foot are used and transverse rolling used. Probably the most extensively used section, especially on main highways, consists of a continuation of the standard crown of the pavement for a distance of 3′ beyond the edge of pavement and then the reverse slope of 2″ per foot for 5 feet. On mountain roads using superelevated curves, considerable care in laying out grades is required on account of the fact that the path of water in many cases changes from side to side. Defined depressions at the point of crossing are undesirable from the standpoint of riding ease and are not necessary for water control.

In constructing these shoulders, the work can be handled in most cases by standard road equipment, although a small amount of hand dressing is sometimes needed. Where road mix material is used, the mixing is completed on the standard center section, and when this mixing has been completed the necessary amount of material for shoulders is bladed into position. Work of this nature is constructed both by contract and force account, in all cases with complete satisfaction.

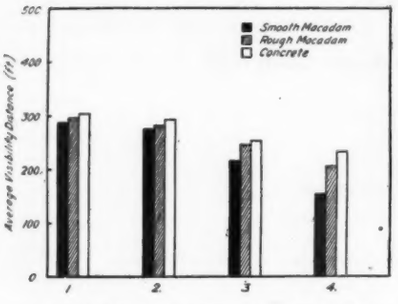


FIG. 1—*Effect of pavement surface (unlighted)*
1. No glare.
2. Opposing car with depressed beam.
3. Opposing car with normal driving beam.
4. Opposing car with illegal (raised) beam.

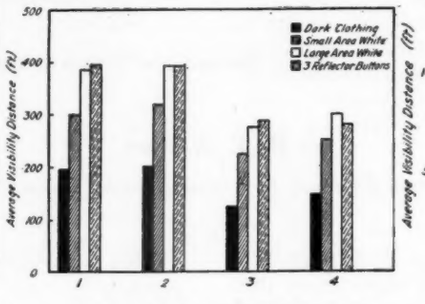


FIG. 2—*Effect of pedestrian's clothing*
1. No glare, rough macadam pavement.
2. No glare, concrete pavement.
3. Opposing car with glaring headlamps, rough macadam pavement.
4. Opposing car with glaring headlamps, concrete pavements.

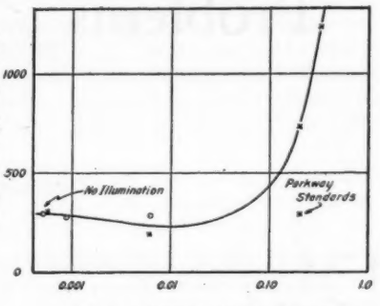


FIG. 3—*Approximate Av. Pavement Luminosity (lumens/ft.²)*

Effect of highway illumination.
o—Rough macadam pavements.
x—Concrete pavements.

Night Visibility Tests on Highways

By Parry Moon* and R. C. Warring**

MORE than 5,000 tests were made during the winter and spring of 1934, to determine the effect of the various factors on the distance at which the driver of a motor vehicle can see a pedestrian at night. These tests were made as a part of the Massachusetts Highway Accident Survey, which was a CWA project, and were reported in full in the *Journal of the Franklin Institute*. A summary is given below.

The type of pavement surface has a relatively small effect, so that the pedestrian is in approximately as much danger on one kind of pavement as on another. Fig. 1 shows the relation of three types of surfaces. Concrete is slightly superior from this viewpoint, but not markedly so. The average visibility distance for concrete is 304 feet, for rough macadam 295 feet and for smooth macadam 288 feet.

A small area of white, such as an unfolded handkerchief, increases the visibility distance about 50%, while light-colored clothing increases the distance about 100%. Fig. 2 shows the various factors under differing conditions. At speeds above 40 miles per hour, a driver cannot see a pedestrian in dark clothes soon enough to stop before reaching him. But if the pedestrian is equipped with reflector buttons, he can be seen quickly enough so that a driver going 60 miles an hour can stop in time. In the case of glare from passing cars, these speeds are reduced to 30 and 50 mph, respectively. Even these speeds are unsafe in unfavorable weather, or with poorly adjusted brakes, sub-normal eyes, dirty windshield, or inattention on the part of the driver.

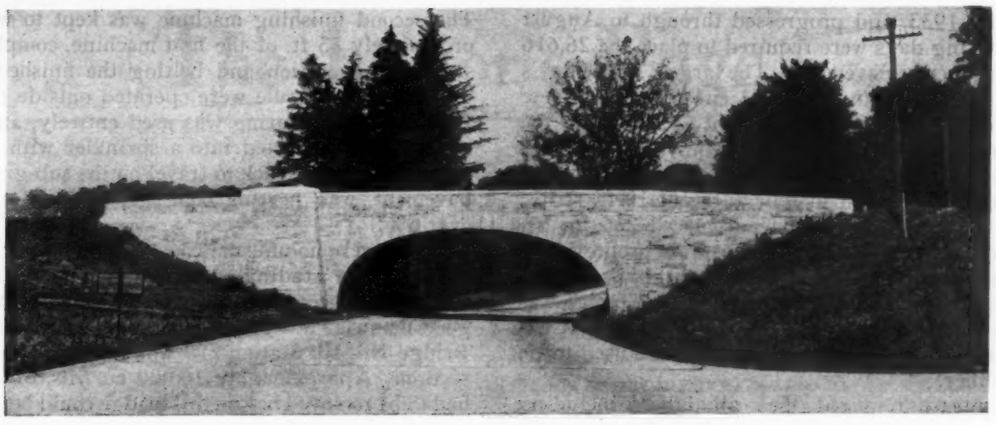
It is safe to say that on an unlighted pavement a pedestrian in dark clothes is always in danger, irrespective of pavement surface or other factors.

There is no particular change in visibility, whether the speed is low or high, the difference being so slight that an average of all speeds is permissible in reporting the results of the work.

Results indicate that 32 cp. bulbs should be used in preference to 21 cp., and that even large lamps are advisable, since the added glare is more than compensated by the increased visibility. The decrease in visibility distance when 32 cp. lamps were replaced with 21 cp., was about 14%, and the results were about the same for all pavement surfaces. The tests further indicated that, in so far as visibility distance was concerned, depressing or dimming was inadvisable.

In regard to highway lighting the tests indicate that with the present types of incandescent street lights and with the pedestrian in an unfavorable position between lamps, no appreciable gain in visibility distance is to be expected unless the average luminosity of the pavement is of the order of 0.05 lumen/ft.² or better. With lower values of luminosity, glare from the street lamps appears to offset the advantages of increased illumination. Fig. 3 shows that as the pavement luminosity is increased about about 0.1 lumen/ft.², however, the visibility distance is greatly improved.

* Massachusetts Institute of Technology
** Electrical Engineer, Boston, Mass.



Hawks Ave. Bridge, Briarcliff-Crotonville Cut-off.

The First New York State Free-Way

By James S. Bixby

Division Engineer, N. Y. State Department of Public Works

THE so-called Briarcliff-Crotonville Cut-off, which affords a convenient and direct connection between the New York and Albany Post Road and the Saw Mill River highway north of Ossining, N. Y., was originally conceived by the Westchester County Park Commission as a tentative parkway route. A location was selected and land acquired. However, before any construction was undertaken, it became evident that Westchester County would not be able to finance all of the projects in its splendid and far-seeing system. One or two sections, therefore, were presented to the State Highway system to be constructed for mixed traffic instead of for pleasure traffic only, as originally contemplated.

When construction was undertaken by the state, in view of the park areas adjacent, the parkway standards were adopted, so that this road is built with integral curb, no ditches, and separation of traffic by stone masonry bridges at all important road crossings. These bridges are according to the design and standard of the Westchester County Park Commission.

The result fulfills the definition of a "free-way," that is a trunk line highway designed for expedited mixed traffic, to which access is permitted only at points designated by the authorities in charge of the design of the project. The areas adjacent to this road are controlled by the Park Commission so that there can be no commercial development, such as hot dog stands, along this road, and access may be had only at points where existing public highways intersect it.

This road, so far as I know, is the first road of the free-way type built in the state of New York. It could be developed under the present law only by the unusual and fortuitous circumstances already outlined. However, a large number of such projects are needed throughout the state, and I have recommended to the Commissioner that the highway law be amended to provide authority for such construction, with access only at designated points; otherwise by-pass routes in this state are bound to develop into alleys of hot-dog stands, which will be a discredit and an eyesore.

The total length of this project was 4.78 miles. With the exception of one or two short strips, and also of a strip of 0.21 mile, the minimum width is 40 feet. Croton Ave. was carried over this road with a rigid-frame, stone-faced arch of 56.67-ft. span; the cut-off was carried under Ryder Road, by means of a 46-ft. span; under Hawks Ave. with a 56-ft. span; over Cedar Lane with a 59-ft. span skew bridge; over Quaker Bridge Road with a 54.33-ft. span; and a 56.16-ft. skew span was necessary to carry the Albany Post Road over the southbound drive. All of these bridges were from 49 to 56 feet wide. Highway connections were also necessary at all of these locations and there were a number of drainage bridges.

Grading contracts were let as far back as 1931. Part 1 grading contract, covering 2.75 miles, included 134,475 cu. yds. of unclassified excavation, approximatly 10% of which was rock, on which the bid price was 27c per cu. yd. The grading on this section was let to Chas. Shaffer & Son. The grading on Part 2, 1.44 miles, plus 0.38 mi. on the Albany Post Road, and two connecting drives was let to Louis D'Angelo. The Part 2 contract included 189,279 cu. yds. of unclassified excavation, approximately 50% of which was rock. The bid price on this was 40c per yard. The two grading contracts were combined into one paving contract which was awarded to A. E. Ottaviano, Inc. This included 69,675 cu. yds. of excavation, approximately 5% of which was rock, and the bid price was 34c. There were 26,616 cu. yds. of concrete placed. A total of 66,940 barrels of cement, or 330 carloads, were used. The total costs aggregated $816,265.

Pavement Construction Methods and Progress

Among the special jobs were the protection of the New York City aqueduct, where the road crossed this; and filling across a swamp with a maximum depth of 42 feet, on which dynamite was used to accelerate the fill. Top soil, stripped by the grading contractors, was spread by TERA forces, the slopes seeded, and some planting done.

Paving on the Briarcliff-Crotonville Highway be-

gan May 8, 1933, and progressed through to August 19; 76 working days were required to place the 26,616 cu. yds. of concrete pavement. The largest single day's pour was on July 10th when 651 cu. yds. of concrete was placed with the usual equipment and working the usual hours. This 651 cu. yds. is equivalent to 1,309 lineal feet of 20 ft. wide pavement, 8 inches thick. This pavement was laid in four adjacent 10-ft. strips, 8 inches thick, with reinforcement placed 2½ in. below the top surface. The aggregates were proportioned by weight, the mix consisting of 1 cement, 1¾ sand and 3½ stone. Premoulded joint material 1 in. thick was placed at 206-ft. intervals to form the slabs. At expansion joints five dowels and sleeves were used to tie slabs together.

The contract required that all labor, including skilled, be secured through the local Relief Bureau. No man was allowed to work more than thirty hours per week. The contractor adopted the plan of starting a shift on Thursday morning working this shift through Saturday and again using the same shift on Monday through Wednesday, then starting a new shift. At first the contractor experienced some difficulties in securing competent help but later this was remedied and the system worked out quite well.

The contractor's mechanical equipment for this job consisted of two 27E pavers, one Multi-Foote, the other a Rex; two Lakewood finishing machines and weighing hoppers for all aggregates including cement.

The sub-contractor who furnished the materials also supplied the power crane at the proportioning plant, batch trucks and transit-mix trucks. The proportioning plant was located on a dock at Croton-on-Hudson. Stone and bulk cement were received by barge along side the dock, the sand being trucked in from a local commercial bank.

At the beginning of the paving operation the contractor's second paver was in use on another job, so it was decided to use the one available paver to place the bottom 5½ inches of concrete. The top 2½-inch section was to be poured with transit-mix trucks. It was found after the first day that, due to an insufficient number of these trucks, the paver had to wait several times a day to allow the top to catch up; it was even necessary at times to bring the paver back to help out. As soon as the contractor's other paver was free it was used to pour the top. This scheme worked out very well and was retained throughout the entire job. Two finishing machines were used, the first working directly in back of the second paver giving the concrete its first strike off. No belt was carried on this machine. The second finishing machine was kept to within approximately 75 ft. of the first machine, completing the screeding operation and belting the finished surface. The pavers as a rule were operated outside the forms. Hay and water curing was used entirely, an old tank truck being converted into a sprinkler with an off-set pipe to allow the truck to travel on the sub-grade. The pavement was herring-bone grooved on all grades over 6%.

There were no unusual construction methods used on either of the grading contracts. The construction of the bridges presented no difficulties, as, on the whole, good material was found in all of the bridge footings. Bridge No. 10, Station 799 was located in a heavy cut section. Approximately 16,000 cu. yds. of excavation had to be removed before this bridge could be built. The construction of the retaining wall station R 801+25 to station R 804+30 became somewhat involved when, upon excavating, clay and very fine sand were found necessitating the use of timber sheet piles to secure the bank and protect adjacent houses. During construction a section of this sheeting gave way before the final bracing was placed, due to a heavy rain, endangering for a few hours the houses perilously perched on top of this steep slope. No serious damage resulted from this mishap.

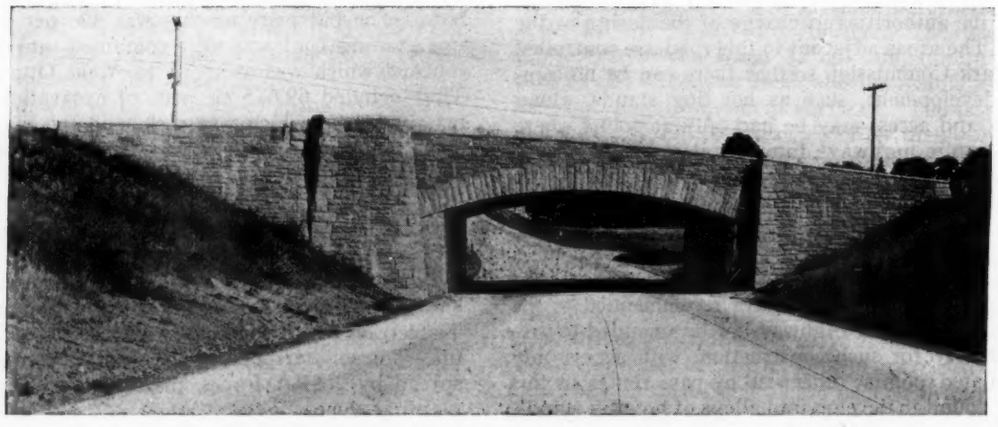
Preparedness in Public Works Planning Is Rewarded

The year 1934 was one of great activity and considerable accomplishment by the Sewer Department of Upper Darby Township, Pennsylvania. It has been the principle of that department to prepare complete plans of drainage projects in anticipation of some day having funds to undertake the work. Having such plans, it was possible to take immediate advantage of the Federal Government's offer of assistance through the Civil Works Administration. During the year seven such projects have been under construction. Four have been completed and three are yet under way.

These projects required a cash expenditure by the Township, for material, tools, inspection and engineering services, of $33,159.34. The contribution of the Federal Government in labor has been over $120,000.

The community has profited by securing valuable additions to its drainage system, and by providing over six hundred of its citizens with employment.

(*From the annual report of the Sewer Committee of Upper Darby Township.*)



Ryder Road is carried over the Freeway on this structure

The Editor's Page

Direct Labor Is Not the Only Labor Helped by Work Relief

The usually staid and accurate *New York Sun* in a recent editorial voiced an opinion which is held by many uninformed people when it pointed out that its opposition to work relief was based on the fact that so much money had to be spent for materials and equipment that the final cost for work relief was much greater than for home relief, if the same number of people were to be taken care of.

No one with any experience in construction or in the broader phases of unemployment relief work would fail to understand that the dollar spent for equipment or for materials will create just as much employment as the dollar spent for raking leaves. A highway construction job employs so many men; that portion of the money spent for sand and gravel, for cement or asphalt or tar, is just as effective in relieving unemployment as the money spent for labor directly on the job.

The above phase, however, is the least important. Every engineer knows that no worth-while work can be done without tools, equipment and materials. The gang equipped with only picks, shovels and wheelbarrows will never erect any structures of permanent value to the community.

Multiple Lanes vs. Multiple Roads

With the coming of spring days, construction crews are out on many of our trunk-line highways, cutting off corners which already were pretty good and straightening out kinks which hitherto had limited our speed to probably 50 to 60 miles an hour.

We believe highway construction is one of the very effective means of promoting employment, while producing structures of real value to the community. And yet we wonder about this type of work.

In railroad operation, it is most desirable to bring in the traffic from the feeder lines, and route it through a highly developed main line to its destination. This main line section must be fully equipped with blocks and automatic control apparatus, have low grades, and 2, 3 or 4 tracks.

Many of our highway engineers had their early training in railroad engineering. Are they now unwisely applying a portion of this training to highway work? In the building of these 3 and 4-lane superhighways, with generally low grades, large-radius curves and very high-speed possibilities, are we not trying to apply to highway users the railroad principles of operation? On the railroad, units (cars) are grouped together in trains and operated, not individually, but as a whole. On the highway, where the traffic comprises the lumbering truck, the moderately heavy freight carrier, the passenger car of the sightseer, and the speedster, all driven by individuals subject only to the remote control of traffic laws, the situation is markedly different.

The question arises whether, in view of our increasing traffic fatalities, the express highway is the answer to modern traffic problems. The express tracks of a railroad, with the traffic under rigid control, is far different from the wide, high-speed highway, filled with all sorts of drivers, as is inevitable under the licensing situation today. Youthful exuberance and a desire for speed, elderly leisure, sightseeing, business demands and occasionally a grouchy disposition lay conflicting demands on our highways.

There are places where the express highway meets and fulfills a real need. But in many other places, traffic facilities between two areas or two cities can best be met by constructing three or four or five 2-lane roads, one or more of which can be set aside for high-speed traffic. The cost of the 2-lane roads may be greater than the cost of one 4-lane road to carry the same number of vehicles. But multiple roads will serve a far wider area, their construction will provide more employment, and they will almost certainly be safer. There are no figures, we believe, showing the relative accident hazards for various widths of roads, based on the volume of traffic; but we believe that most drivers will agree that the hazard increases with the number of lanes in use, traffic per lane being equal.

Charging Bidders for Plans and Specifications

"In looking over advertisements for bids," writes a subscriber, "we note a growing tendency on public works projects to require contractors to pay for plans and specifications. In fact, nearly every recent project has required the payment of from $5 to $25 to obtain plans."

We have always felt that contract construction should be a cooperative project for doing the best job for the community at the lowest cost. Contractors do not (or at least should not) manufacture their own money; whatever they have must be made from construction projects. In the long run, the cost of construction is going to be the cost to the contractor plus a reasonable profit. Personally, we do not wish to act as engineer on a job on which a contractor loses money, though sometimes it is unavoidable to have such a loss.

Every cent of burden that is placed on a contractor comes back to weigh down other construction projects. If he bids on ten jobs before getting one, the one job he secures has to cover the fairly heavy expense of preparing estimates of cost and making bids on the other nine. If he is to be burdened further by having to pay for plans, he must add that much more to the job.

Of course, he can bid low and get a job, but the result of bidding too low is almost always delay and loss to the community, and sometimes inferior work as well.

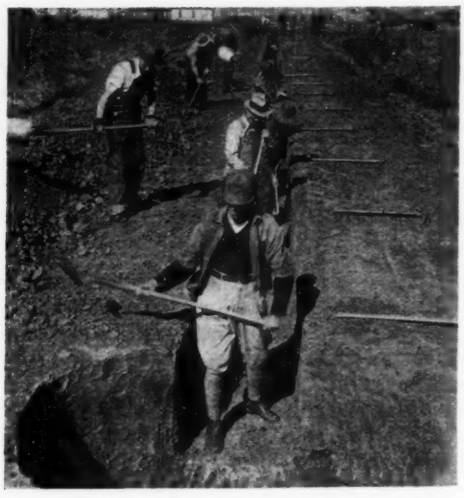
Plans are prepared for the owner or the community and must be used by contractors as a basis of bidding; and in order to secure the greatest number of bids, the expense of preparing and issuing them should be borne by the community, without direct expense to the contractor. A deposit for the plans is good practice, for it discourages many curiosity seekers; but a direct charge for plans approaches a petty racket.

Sewer Construction in Oklahoma City Under Federal Relief

By Virden A. Rittgers

Office Engineer, Engineering Dept., Oklahoma City

In the March issue of PUBLIC WORKS *we published a description by Mr. Rittgers of "Pavement Construction in Oklahoma City Under Federal Relief." In the following article he describes the sewer construction similarly performed last year. The method of financing this work and assessing for same was described in the previous article.*



Excavating for sewer. Note CWA safety method of placing picks

PRACTICALLY all of the lateral sanitary sewers laid with Federal relief in 1934 were 8 inches in diameter. The use of clay pipe and cement-concrete pipe was about evenly divided. Most of the work promoted through local dealers called for the cement-concrete pipe since there were two local manufacturers of this material. Most of the pipe purchased through the city trust fund was clay pipe. While the city's standard specifications call for A. S. T. M. pipe for ordinary pipe sewers, a large portion of the clay pipe laid under this program was No. 2 quality. We permitted this in order to keep the cost down, in view of the fact that naturally the larger unsewered areas were in the poorer districts of the city.

Bituminous joint materials were used exclusively. For ordinary work, a hot mixture of 40% asphaltic cement and 60% limestone dust was prepared on the job. In wet trenches, a bituminous mastic material was used. It was the usual practice of the pipe laying crews to pour one-half of the joints before the pipe sections were lowered into the trench. This was done by standing two sections on end, one on top of the other, and pouring the hot asphaltic joint between them. After the joint material had hardened sufficiently, the two sections were lowered into the trench. The diameter of the city's standard brick manholes was 3′ 6″, but this was changed to 4′ 0″ during 1934. The department uses minimum grades of 0.60% whenever possible, based on a 2 ft. per sec. velocity with an '*n*' of .015. Six-inch sewer pipe wyes were put in for all existing houses and for all future building locations. Where the depth of the sewer was greater than 7 feet, 6-inch ⅛ curves and 6-inch risers were put in to bring the capped connection to within 7 feet of the ground surface.

Trenches, ranging in depth to 28 feet with an average of from 10 to 12 feet, were excavated through materials varying from solid rock to quicksand with flowing water. All excavation was made by hand methods, with the use of air drill outfits permitted in hard shale and rock formations. In outlying locations, blasting with 40% dynamite was done. On one project an air drill outfit and pump outfit were operated at the same time. In some trenches, no sheeting was required, in others it had to be solid, 2″ x 8″s and 2″ x 10″s vertical with 3″ x 12″ oak walers being used. At the height of the program in early 1934, trench jacks were being feverishly sought from all corners of the United States.

In constructing 8″ lateral sewers, the largest amount laid in one day on one project was 1,200 feet. Three hundred men, in two gangs, were on this project. During our sewer construction program, we had two or three projects which gave a degree of variation in the type of work. One was a branch outfall sewer, from 12″ to 24″ in diameter and 10,000 feet long. Another was a 33″ main sewer 7,600 feet long and containing two inverted siphons and two short reinforced concrete sewer branches. The largest amount of the 33″ sewer laid in one day was 200 feet. The maximum force on this job was 600 men working in two 4-hour shifts of 300 men each.

The 24th Street Main Storm Sewer

Our prize sewer project was a monolithic rectangular reinforced concrete main storm sewer varying in size from 4′ 0″ x 4′ 0″ to 5′ 0″ x 5′ 9″. This was known as the 24th Street main storm sewer and was 2,900 feet long, extending from Shartel Avenue to Douglas Avenue. Most of the way, the sewer was laid down the parking, the existing sidewalk having to be removed. The depth of excavation ranged from 9 feet to 25 feet, and was made mostly through firm soil, although a small amount of hard shale was encountered. The forms for this sewer were designed to permit ready removal, moving ahead, and resetting. Twelve 16-foot sections were constructed. We used them in two sets, each 96 feet long. After the work got started, the general method of construction was as follows: The bottom slab was poured in advance and kept at least 192 feet ahead of the barrel. A 96-foot gap in the sewer barrel was left and then 96 feet of forms set and the barrel poured. While this section was curing for 48 hours, the other 96-foot section of forms was skidded forward and placed in the gap behind the advanced forms and that

section poured. Then the advanced forms were moved ahead 192 feet, leaving another gap. This sequence of operation was repeated over and over.

The concrete used in this sewer, and for that matter in practically all sewer structures, was our Class "B" concrete which was specified to contain 5.2 sacks of portland cement per cubic yard of mixed concrete. The approximate mixture was specified to be 1:2.25:3.75. This mixture was intended to develop 3,000 lbs. compressive strength at 28 days, with slumps approximately 4" to 6". In order to permit 48-hour removal of forms, we specified high-early-strength portland cement for the concrete in the top slab of the sewer section. Cylinder tests on this concrete cured under job conditions with average daily temperatures of approximately 60 degrees showed an average of 670 pounds per square inch at 48 hours, 2,300 pounds at 7 days, and 3,150 pounds at 28 days, where regular portland cement was used. With H-E-S cement, the strengths were 1,750 pounds at 48 hours, 3,500 pounds at 7 days and 4,400 pounds at 28 days. The contract for this concrete called for it to be mixed-in-transit and be discharged into the forms. All reinforcement steel was bent on the job.

In most cases excavated material was piled along one side of the pavement adjacent to the ditch, but not all of it could be so placed and we were forced to close off one block of a side street adjacent to a city park and store material some 15 feet high. We were fortunate in not having to sheet this ditch solid at any point, but 6" x 6" braces approximately 10 feet long with trench jacks set in one end were used between 3" x 12" oak walers.

Incidental items of work done in connection with the 24th Street main storm sewer included the construction of approximately 2,000 linear feet of 5-foot concrete sidewalk, the cutting back of thirteen corners at pavement intersections, the building and connecting up of several batteries of sewer inlets as well as several single and double inlets, the replacing of pavement on nine cross streets, the building of an overflow connection between an old main sewer and the new sewer, and a sanitary sewer inverted siphon. One single and one double street railway track were tunneled under.

Construction on this sewer began on January 2, 1934, and was substantially completed on June 1, 1934. The maximum number of laborers used at one time was 500 men working in two 4-hour shifts of 250 men each.

One difficulty which has been with us throughout the work relief program and which is inherent in this kind of a set-up, as contrasted with a private contracting organization, is that on certain occasions we were asked to work more men than good practice would dictate. The routine system called for requisitions to be sent from our office to the local relief office for workers and trucks, a few days in advance of needs. However, we could not always depend on receiving the number of men and trucks requisitioned. A situation of this kind is particularly acute if there is delay in getting materials. On the other hand, the supply of men was unexpectedly shut off on certain occasions. However, we feel that we have been very fortunate in only losing a small amount of sewer ditch on one or two occasions due to this situation.

During 1934, the Engineering Department constructed the following lengths of sewers, using Federal relief labor:

8" to 15" sanitary (mostly 8").....58,128 lin. ft. or 11.00 miles
27" and 33" sanitary ..... 9,292 lin. ft. or 1.76 miles
4'-0" x 4'-0" to 5'-0" x 5'-9" storm.... 2,984 lin. ft. or 0.57 miles

Over the entire period from September 1, 1931 to December 31, 1934, the following lengths of sewers were constructed using City or Federal relief forces:

8" to 24" sanitary .....157,389 lin. ft. or 29.80 miles
27" and 33" sanitary ..... 9,541 lin. ft. or 1.81 miles
39" to 42" sanitary ..... 10,050 lin. ft. or 1.90 miles
Total—Sanitary .....176,980 lin. ft. or 33.51 miles
15" to 48" storm ..... 2,944 lin. ft. or 0.56 miles
4'-0" x 4'-0" to 6'-10" x 7'-3" monolithic storm ..... 6,567 lin. ft. or 1.24 miles
Total—storm ..... 9,511 lin.ft. or 1.80 miles

The following table gives data as to per foot costs of some representative sewer projects (including three private contract jobs.)

Sewer Costs Per Lin. Ft.

Length and Size	*Costs per Lin. Ft.*			
	Materials	*Labor*	*Supt., Equip. Engr.*	*Total*
Federal Relief				
866'-8"	0.47	1.47	0.22	2.16
365'-8"	0.33	1.20	0.25	1.78
2292'-8"	0.34	3.20	0.36	3.90
1804'-8"	0.63	3.01	0.51	4.15
5472'-8" & 10"	0.99	6.23	0.42	7.64
Private Contract, 1931				
638'-8"				1.96
1137'-8"				2.04
305'-8"				3.66

The variations in labor cost on these projects are due, mainly, to variations in kind and quantity of excavation. The project which cost $7.64 a foot was in heavy cuts ranging up to 28 feet, which necessitated four lifts or relay boxes to remove material from the trench bottom. A large percentage of this excavation was solid rock. This project also was overloaded with labor for

24th Street Sewer completed with new sidewalk in place

awhile at the outset of the C. W. A. program. In general, the additional cost items of overhead, profit, and warrant or bond discounts on contract work just about offset the increased cost of hand labor (using relief workers on the force account projects.

The 24th Street main storm sewer cost a total of $90,352.90 and this cost was about the same as had previously been estimated by the department on the contract basis. In 1932 the city took bids for construction of the Santa Fe storm and sanitary main sewer (a 24" sanitary line below a 6'-10" x 7'-3" storm sewer) and then built the job by force account. The lowest bid was $64,277.31 and the city's final total cost was $62,634.92.

How the Plan Has Worked Out

There are fewer disadvantages in constructing pavement work with relief laborers than in constructing sewers, where the crews of men are larger and excavation is a greater proportionate item. This fact is reflected in the comparisons of unit costs, the contract work on pavements costing more than the force account work.

By and large, the city administration and the citizens of Oklahoma City are highly pleased with the program of pavement and sewer construction under the Federal Relief setup. We consider that we have been fortunate in that no one cent of refund from the Sewer Trust Fund has been requested or made necessary, and no property owner so far as we know has ever refused to pay for any of the thousands of dollars worth of materials delivered on our order. We think that the costs on this work and the progress of construction have been satisfactory, especially when one considers that under the work relief arrangement there is not the desired flexibility of control over the size of the labor crews, the amount and kind of equipment, and the skill and ability of the men.

At the outset of our program, several local contractors raised quite strenuous objections, but as the work gained momentum, the method seemed to be accepted as inevitable, at least for the time being. While it is by no means our attitude that all municipal improvements should be constructed by force account methods, we do firmly believe that no more than a small fraction of the works of permanent improvements accomplished in Oklahoma City during the past three years could have been done in any way other than by the use of Federal Relief forces under the supervision of the Engineering Department.

Beginning the 24th Street main storm sewer

Cotton Fabric in Gravel Roads

Experimental work in the use of cotton fabric on gravel roads is being conducted in New Jersey, apparently with promise of success. It was begun last August by South Brunswick Township, in connection with the construction, with aid from the State, of a gravel road on Stultz Lane.

The gravel road, which had been put in good condition, was given a prime coat of tar and cotton fabric was then applied in strips over a stretch of 600 ft., eight strips being applied to a total width of 18 ft. A light application of sand then was made to the fabric to prevent the material from being picked up by the wheels of the tar distributor, except for 100 ft. at one end of the stretch. Hot tar was then applied and was covered with stone, both materials and quantity complying with the state specifications. The work was directed by Mr. Everitt, representing the Cotton Textile Institute.

The cotton fabric used, which is known as "Osnaburg," weighs 4 ounces per square yard and has a thread count of 20 x 12 per square inch. It was shipped in strips 34 in. wide and in lengths varying from 60 to 200 yards. It was received folded and was rolled on sticks at the job and spread over the road by rolling from these sticks. The material cost 6.5 cts per lineal yard at the mill, equivalent to approximately 8 2/3 cts. per square yard. Adding cost of freight and handling, the use of it would add approximately $1,000 per mile to the cost of an 18 ft. road.

It is claimed that the fabric acts as a reinforcement for the bituminous material and will increase the life of the road and save maintenance. On Monday, January 21st of this year, E. E. Reed, supervisor of State-aid projects, made an inspection of this road and reported as follows:

"On Saturday night it snowed and Sunday and yesterday we had a light rain most of the time so that the road and the adjoining ground was saturated. On the non-cotton section there were about twelve places where the surface had broken. These ranged from 1½ square feet in area down to ½ square foot. These spots were quite soft and other sections of the road were resilient even while walking over them. By pressing on the surface in certain sections with a blunt instrument it was possible to see water ooze through the surface mixture. This was also noticeable when a car went over certain sections.

"There were no broken places whatever in the section that had been treated with the cotton fabric. This section was much tougher than the other section, and there were some spots where there were indications of the water having oozed through to the surface under traffic. These sections, however, were not broken. The surface was not as easily broken with a screw driver as the section that had not been treated. The cotton fabric section was intact and it was possible to raise the surface and the surrounding surface for eight or ten inches from the puncture. The cotton fabric section was much tougher than the section that had not been treated and was not as pliable nor as resilient while walking as the non-treated section."

Chemical Treatment of Sewage at Dallas*

By E. W. Steel† and P. J. A. Zeller‡

THE sewage treatment plant at Dallas finds itself in a position of incipient overloading, according to Trinity river survey data still in process of collection. The several advantages claimed for chemical precipitation looked attractive, hence, an intensive study of chemical precipitation was proposed. This study was made by Edgar Whedbee, sanitary engineer, Dallas Water Department, and P. J. A. Zeller, A & M College, the project being a cooperative effort on the part of the City of Dallas and the Texas Engineering Experiment Station. The results are to be published in full in the near future.

The first part of the work comprised a laboratory study of the several chemicals commercially available. It covered a period of approximately one year, and included more than 200 experiments. The chemicals used were ferric and aluminum chloride, ferrous and ferric sulphate, chlorinated copperas, and alum. In every case, coagulation was tried over a pH range from 2.0 to 12.0. Auxiliary chemicals such as acid and alkali, chlorine, permanganate, inert materials, and air were tried in various combinations.

Only a brief summary of the results is possible in this paper. Any one of the chemicals tried, and, no doubt, others which have not been tried, would coagulate Dallas sewage. However, the conditions under which the different chemicals worked most effectively showed wide variations. The results achieved also varied somewhat, as expressed in percentage removal of suspended solids and B. O. D. In these studies, 75 per cent removal of B. O. D. and 80 per cent removal of suspended solids were selected as the criteria of successful operation.

In general, ferric chloride seems to be the best coagulating agent, closely followed by aluminum chloride. In both instances, however, reaction control to the acid side is essential for a minimum chemical dosage and cost. The amount of soluble iron passing through the coagulation process is negligible.

Based on the laboratory results, a miniature plant was constructed. All construction was of standard engineering units and nothing fancy or special was used. The plant was operated for a period of nine months and handled about 235,000 gallons per day.

Right at the outset and throughout the experiment, the ferric chloride generator gave plenty of trouble. It may be asked, then, why ferric chloride was generated instead of purchased. There are two reasons: financial and chemical. In Dallas, iron turnings can be had for hauling charges, and chlorine in ton cylinders was obtainable at 2½ cents a pound delivered. The laboratory experiments showed that freshly prepared ferric chloride was more effective as a coagulating agent than the commercial salt or solution. Only one-third of the chlorine used appeared in the ferric chloride generated. Tests proved there was no appreciable loss by leakage. Later, by careful testing and experimentation, 95 per cent or more of the chlorine was accounted for. It was also developed that a goodly share of the chlorine, 35-40 per cent, was converted into free hydrochloric acid. This acid had an important effect in reaction control; and checked the laboratory findings regarding need for pH adjustment.

Another problem was the production of ferric chloride. When chlorine water is passed over iron turnings the result is ferrous chloride, a chemical with little or no coagulating value. Theoretically, one-third of the chlorine should be added after solution to convert the ferrous iron to ferric. Here is an example of the fact that theory and practice frequently do not agree. Actually, the amount of oxidizing chlorine is much less, probably due to the fact that free hydrochloric acid is formed. These difficulties indicate the necessity for close supervision and checking of the product formed. During operation, the ferric chloride fed into the plant had not even a trace of ferrous chloride, except under certain conditions.

As regards the appearance of the treated sewage, Mr. Whedbee was frequently accused of displaying city water as the treated effluent. As a matter of fact, because the sewage plant has no city water, the chemical effluent had to be used in making solutions. Before so using it, however, it was passed through sand beds operated on the rapid sand filter principle.

The chemical effluent showed an average B. O. D. removal of 77 per cent and suspended solids removal of 86 per cent over the whole period of the tests. It was clear and visibly better than the effluents from Imhoff tanks or plain settling tanks. These results were obtained by the use of 700 to 1500 pounds of chlorine and 200 to 400 pounds of scrap iron per million gallons treated. The ferric chloride generated and applied amounted to 650 to 1200 pounds per million gallons.

It should be noted that the raw sewage had an average B. O. D. of 350 ppm and suspended solids 350 ppm. The Imhoff tanks accomplished a B. O. D. reduction of 46.3 per cent over the same period and a suspended solids reduction of 54.2 per cent.

Unfortunately, the cost of treatment was high. Depending upon conditions, the process cost $25 to $50 per million gallons. The chief item of cost was the chlorine. Any process which will convert chlorine more completely into ferric chloride would help reduce the cost and thereby tend to make the process more feasible from an economic standpoint.

The appearance of the settling tanks was pleasing. There was at all times a minimum of floating solids. Especially important is the fact that there were no odors. Thus, a few of the claims for chemical precipitation were vindicated.

*Part of a paper before the Texas Section of the Southwest Waterworks Association.

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Flow Test on Asbestos-Cement Pipe

By Edgar K. Wilson
Chief Engineer, The Pitometer Company, New York, N. Y.

THE first flow test on American-made asbestos-cement pipe was made in February, 1935, at the Garfield, N. J., plant of the Forstmann Woolen Company. The line tested consisted of about 1,500 feet of 14-inch Class C pipe, used to convey water from the city main into the Forstmann plant. The line had been in service for slightly over two years at time of test. The tests indicated a Williams-Hazen coefficient of about 145.

The water carried in this line is treated at the Little Falls filter plant of the Passaic Valley Water Commission, and after treatment shows the following average of monthly tests:

	Parts per million		
	Max.	*Min.*	*Aver.*
Silica turbidity	0	0	0
Hardness	59	39	46.7
Alkalinity Na_2CO_3	30	16	22.9
Incrustants	39	18	24.9
Total solids	114	83	98.2
Iron	0.2	0	0.10
Chlorides	7.1	4.2	5.8
Carbon dioxide	15.0	8.0	11.2
So_4 as Na_2SO_4	57.0	28.0	43.9
Sodium	13.8	7.9	10.9
Magnesium	5.4	3.9	4.7
Calcium	19.4	12.4	15.9
Aluminum oxide	2.5	1.2	1.9
Hydrogen ion	6.7	6.4	6.5

300-ft. Section Tested

The test section used for determination of loss of head was 300 feet long. The pipe appeared to be nearly level but it was noted that it was not absolutely straight, probably due to the flexible joints which allowed the pipe to shift slightly as the filled ground settled. The diameter of the pipe was carefully measured by means of a special caliper inserted through a 1 inch corporation cock, and found to be 14 inches.

The loss of head in the 300-foot test section was measured in a differential U-tube which contained a liquid of suitable specific gravity. The deflections were measured in feet by means of a wooden rule with divisions of one hundredth of a foot.

The pressure at the upstream end of the test section was transmitted through a ¾" corporation cock into about 300 feet of ¾" garden hose, and thence to the U-tube located at the downstream end of the test section. The pressure at the downstream end was transmitted from the ¾" corporation cock to the U-tube by means of 6 feet of ¼" rubber tubing.

The velocity of the water was measured by a Pitometer inserted into the pipe through a 1" corporation cock located three feet below the downstream end of the test section. The pipe factor at this gaging point was carefully determined by five vertical traverses at five different velocities. During the test the Pitometer was located at the vertical center.

Conduct of Tests

The tests were made on Saturday, when the plant was shut down, which avoided trouble from irregular surging flow. In preparation for testing, air was thoroughly drained out of all hose connections and U-tubes. A zero check for both the velocity and friction head manometers was obtained when the line was shut down during the tests. The Pitometer was reversed several times to check the zero reading. The manometers were kept at a constant temperature as indicated by a thermometer suspended beside them. The specific gravity of the measuring liquid was carefully determined in the U-tube immediately at the close of the tests.

Four different velocities were produced in the pipe by means of valves which were operated inside the plant. These velocities remained constant during the tests.

After the discharge had been set to a desired value, about five minutes was allowed to elapse to secure steady flow conditions. Then five readings of the velocity deflection were taken, followed by ten readings of the loss of head deflection, then five more velocity readings followed by ten more loss of head readings, and finally five more readings of the velocity deflection. This procedure constituted a run, so that each run contained twenty readings of the loss of head, and fifteen readings of velocity.

No runs were discarded for any reason. A complete tabulation of results is given below.

Loss of Head Tests on 300-ft. Section of 14" Asbestos-Cement Pipe

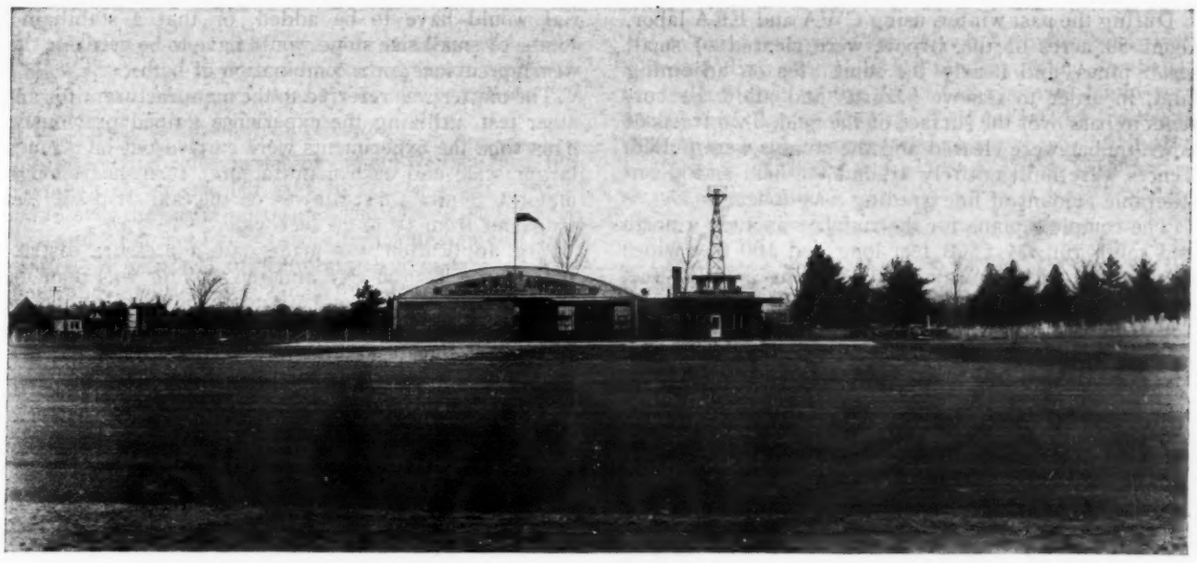
Run No.	*Velocity*	*Total Loss, Ft.*	*Loss per 1,000 Ft.*	*Coefficient Williams & Hazen Formula*
1	0.749	0.0449	0.1495	144
2	0.750	0.0438	0.1461	146
3	0.750	0.0436	0.1455	146
4	0.721	0.0391	0.1304	149
5	1.415	0.1482	0.494	142
6	1.426	0.1534	0.5115	141
7	1.435	0.1469	0.4895	146
8	1.435	0.1600	0.5335	139
9	1.845	0.2435	0.812	142
10	1.849	0.2398	0.7995	144
11	2.839	0.542	1.807	142
12	2.840	0.5395	1.799	142
13	2.840	0.541	1.804	142
14	2.838	0.531	1.771	143
15	1.467	0.1435	0.4785	151
16	1.459	0.1428	0.4765	150
17	1.460	0.1288	0.4295	158

From a study of the data, it appears that an average co-efficient of 145 is very nearly correct for this pipe.

Footways for Highways

The following plea for footways is given in the current "Bulletin of the Permanent Industrial Association of Road Congresses":

"Above all perhaps the most important matter is the creation of adequate footways in rural areas, adequate not only in width, but in surface. There appears to be no valid reason why the pedestrian with a thin leather sole and a crop of corns should be expected to walk upon a rougher surface than is provided for a well-sprung motor car with rubber treads an inch thick. The plea that pedestrians will not use footways is disproved by the experience gained in towns and suburbs where footways are well maintained, and where the public invariably use them."



This view from the North-South runway shows the completed approach to the hangar and the administration building.

Developing and Constructing a Municipal Airport

By George C. Stanley

City Engineer and Superintendent of Streets

BURLINGTON, Vermont, the "Queen City" of the State, is located on the eastern shores of historic Lake Champlain. A typical progressive New England city with a population of 25,000, Burlington has been foresighted in many of its municipal undertakings, which have resulted in municipal ownership of its Electric Light Department; Water Department; rock quarry; sand and gravel screening and washing plant; asphalt heating and mixing plant; and last, but not least, its municipal airport.

All of the above mentioned municipally owned and operated plants have proved themselves assets to the city; some are sources of income to the city treasury, and a relief to the tax payer. Funds expended for the construction and equipping of a modern airport look, to some, like a wilful waste of the taxpayers' money, but to those who have a vision of the future of air transportation, it is an investment which the people of a progressive city can ill afford to miss.

Airport Location and General Description

The airport is located about three miles from the center of the business section and about two miles outside of the city limits, on the state highway between Burlington and Montpelier.

The site was leased in 1921, but was purchased by the city in 1930. The area is about 95 acres, with 8½ acres more under lease with an option to purchase. The whole area is on a comparatively level plateau; the subsoil is a very fine grade of sand covered with a thin layer of sandy loam.

The hangar was erected in 1929. It is a typical steel framework structure with corrugated steel sides and roof; the inside dimensions are 80 feet by 60 feet; doors open the entire front of the building. It has a reinforced concrete floor, and a reinforced concrete ramp 50 feet wide and 180 feet long extends out to the loading area.

The water supply is furnished from a 6-inch driven well, 136 feet deep, equipped with an automatic pump with pressure storage system.

The original Administration Building was burned in 1931 and a new one has been erected which is patterned after the design of the Century of Progress Airport Building.

The main floor has a large public waiting room and office in the front half, giving a full view of the entire field. Rest rooms are provided for men and women and living quarters for the use of the airport manager and his wife. The kitchenette is furnished with the latest electrical refrigeration and cooking equipment, and meals are prepared and served to pilots and passengers. The manager's office is equipped with telephone and radio service, electric clock, wind velocity gauge and airway maps of the United States. The furniture is of the modernistic metal type.

The roof of the building is designed as an observation platform. Above the roof is an extension in the shape of a pilot house. Directly above this is a steel beacon tower ready for installing a regulation revolving beacon. A complete electric switch control board is located in the field manager's office which will control the entire lighting system of the field, office and hangar. The field lighting system has not been installed.

Runways and Field Construction

Several years ago two runways were developed by plowing, harrowing, leveling and seeding with grass seed to maintain a sod surface. A 100-foot diameter circle was constructed at the intersection of the runways, of gray limestone dust.

During the past winter, using CWA and ERA labor, about 50 acres of the airport were cleared of small scrub pines, and nearly the same area on adjoining land, in order to remove hazards and allow air currents to pass over the surface of the field. Two tracts of large timber were cleared and the stumps were pulled. Fences were built entirely around the field and a considerable amount of fine grading was done.

The complete plans for the runways include a north and south runway 2500 feet long and 100 feet wide; an east and west runway 2600 feet long and 100 feet wide and a "taxi strip" or approach 350 feet long and 180 feet wide, in addition to the concrete "ramp" or warming-up area in front of the hangar abutting the "taxi strip." Of the north and south runway, 2200 feet are surfaced 100 feet wide with mixed-in-place gravel, bound with Colas asphalt emulsion, with a non-skid, stabilizing surface of ¾ inch limestone. The approach strip has also been graded and the surface has been completed on 100 lineal feet for its entire width. The remainder of the approach strip has received a priming coat of asphalt emulsion and a thin layer of gravel has been rolled into the priming coat to protect the subgrade and to eliminate the dust nuisance until more funds are made available for completing the job.

Runway Surface Experiments

With our limited funds, the problem became one of determining what materials could be used for obtaining a satisfactory surface for the runways. In order to receive a "Class A" rating when the field is completed, the runways must be 2000 feet in length and 100 feet in width. The total amount of money available for surface construction was about $10,000. This meant that we could only spend about 45c per square yard for the complete surface construction.

It was decided to run tests with different bituminous materials, using the natural soil after removing the sod. Four bituminous material manufacturers were furnished with samples of the soil for laboratory analyses and tests. From the results of these, each manufacturer recommended a certain grade of bitumen and submitted a quantity of material for field experiments under our own supervision and under actual working conditions. The results from these experiments were not at all satisfactory. The soil seemed to be much too fine for this grade of work and it appeared that some coarser material would have to be added, or that a stabilizing course of small size stone would have to be used for the wearing surface; or a combination of both.

The matter was referred to the manufacturers for another test, utilizing the experience gained previously. This time the experiments were carried out on a much larger scale and each manufacturer furnished enough material to mix a test runway on the taxi strip 250 feet long and from 10 to 20 feet wide.

The application was made with a pressure distributor owned by the city and the mixing was done by tractor power using spring tooth harrows and wire broom drags, in the same manner as the final work was to be done. The test runways were then rolled and permitted to stand for a few days before adding the stone chips or gravel and seal coat. They were then thrown open to traffic for a period of several weeks. At the end of this test period "Colas" asphalt emulsion was selected. This selection was based upon the ease with which the materials could be mixed with the field equipment, and on the general appearance of the test strips after the rigorous usage of the planes.

It was also decided to haul washed river gravel from a deposit about four miles from the field and spread it over the entire area of the runway to form the "mixed-in-place" surface.

Drainage System

A most important feature of any airport is good drainage. Regardless of the nature of the soil, there are certain seasons of the year in this northern climate when even the most porous soil is unable to take care of surface drainage. The frost line generally penetrates to a depth of about 3 feet in the sandy soil of our airport, so our drainage system, consisting of corrugated galvanized metal pipe coated with asphalt and perforated with small holes on the lower half, was installed at a depth of 4½ feet below the surface and connected with a system of concrete catch basins located every 250 feet along each shoulder of the runway. This system acts as an underground drainage system as well as a surface drainage system. The pipes range in size from 6 inches to 15 inches and empty into a ravine at the south end of the north-and-south runway. There are 26 catch basins installed at present and this number will be increased as the east-and-west runway is developed.

The completed section of the North-South runway, 100 feet wide and 2,350 feet long, surfaced with Colas asphalt emulsion.

The east-and-west runway is now being graded with VERA labor and will be completed in accordance with the approved plans as fast as funds are provided.

Runway Construction

In the actual construction of the runway surface, the river gravel was hauled and spread to a depth of 3 inches over the entire north-and-south runway, 100 feet wide and 2200 feet long. The asphalt emulsion was then applied by pressure distributor in successive applications of ½ gallon per square yard and thoroughly mixed with the gravel by the use of spring-tooth harrows drawn by farm tractors. Before the fourth application was made, a light layer of crushed stone (about 50 pounds per square yard) ranging from ¾ inch to 2 inches in size was spread over the entire surface and rolled into the gravel and emulsion mixture. The entire surface of the runway was then covered with a very light coating of ¾ inch stone to form a non-skid surface and this was broomed into the voids of the larger stone with a steel drag broom. This gave the surface a uniform texture. To prevent the small stones from being picked up by the action of the propeller blade, a seal coat of emulsion was applied at the rate of ¼ gallon per square yard and the whole surface was given a final rolling with a 10-ton tandem roller. A smaller tandem roller weighing about 1½ tons was found very useful in rolling out the small ridges left by the heavy roller wheels. As soon as the seal-coat was finished it was opened to traffic, and has been giving satisfactory service ever since.

Winter Conditions and Snow Removal

In order to maintain daily service throughout the winter months, the Street Department uses its largest piece of snow fighting equipment to plow the snow from the runway after every storm. Several times after recent heavy snow storms, the Burlington municipal airport was the only airport between Boston and Montreal which had its runways plowed free of snow and in shape for the regular schedule landing of the airmail plane.

The Airport commissioners are John J. Burns, chairman; Richard H. Spear; and Alfred H. Heininger, secretary.

Practically all of the developments at our airport have been constructed with force account labor and city-owned equipment, under the direction and general supervision of the writer.

Sewage Treatment Methods for New York

New York City has in operation 16 sewage treatment plants—8 fine screening, 3 of them using chlorination also; 6 coarse screening and sedimentation, one of them using chlorination, and 4 so overloaded as to be practically useless; and 2 plants with coarse screening only. The plans prepared for treating the entire city's sewage include 38 plants, of which the largest—the Wards Island activated sludge plant—was about 20% completed when construction was stopped about two years ago by the financial situation, and another, the Coney Island plant, is about to be begun, contracts for it having been let in February. These two plants are designed for an ultimate capacity of nearly one-third of the city's sewage.

In a paper before the American Society of Civil Engineers (*Civil Engineering* for March), Richard H. Gould, engineer in charge of sewage disposal, New York City, explained the opinions of the engineers on which they based their selection of type of plant for each location. Effluents discharged into different parts of the city's water front—rivers, bays, harbors, etc.—should all be treated, but not to the same extent, nor to as high a degree in winter as in summer. In studying the efficiency of the several processes "The importance of sludge removal would appear to be much greater than is disclosed by the five-day B. O. D. test. The addition of chemicals may distort short-time tests by retarding bio-chemical action."

"For congested sections of the city, a short period of sedimentation or its equivalent is probably the solution. . . . Particularly as regards intermittent treatment, the high cost of chemical treatment may be counter balanced by considerations of compactness and lower initial cost. . . . Where an adequate site is available, power rates are low, and a high degree of treatment is required, the activated sludge process is looked upon with favor. At the rate of 7 mills per kwh, with a load factor of 100%, which will be available at Wards Island, the power cost of air compression for aeration tanks is estimated as less than that for pumping and only from 35 to 40% of the cost of chemicals necessary to effect a somewhat lower degree of purification. It is felt that the cost of power is less likely to fluctuate with changing market and industrial conditions than is the cost of chemicals. . . . As a final measure for protecting bathing beaches from direct bacterial pollution, dependence is placed on the well-tried process of chlorination."

As to sludge disposal, "For the large plants the barging of liquid sludge and its disposal at sea ten miles or so from land has the advantage of simplicity and is the most economical method now available. It is in use in the metropolitan area by the Passaic Valley Sewerage Commission, and so far as known there are no valid objections to it as a means of disposal. Valuable fertilizing products can be recovered from sewage sludge, and probably attempts will be made along these lines. It does not now appear practicable from the standpoint of available sites or of economics to convert the sludge of the entire city into fertilizer. However, the Park Department has a large demand for fertilizer and it appears practicable to meet this to a considerable extent."

The Coney Island plant will employ chemical precipitation by iron salts, flocculation, sedimentation, rapid filtration and chlorination; sludge digestion with use of sludge gas to generate electricity for sewage pumping and other plant use; and vacuum filtration, the dewatered sludge being used to provide humus in a large park to be developed by dredging sand from adjacent waterways. During the winter months chemical treatment and chlorination will not be used.

This treatment was selected for this plant because the size of the area available is not adequate for the full development of an activated sludge plant, power rates there are abnormally high, and the very great dilution at the outlet makes a high removal of B. O. D. unnecessary, and a high degree of clarification and bacterial purity is necessary only during the bathing season. These conditions "favor the compactness and lower initial cost secured by chemical treatment." Sludge disposing by barging to sea would be expensive because of the relatively small amounts to be removed, and the stream on which the plant is located is subject to closure by ice in winter.

A Digest of the Sewerage Literature of the Month giving the main features of all the important articles published.

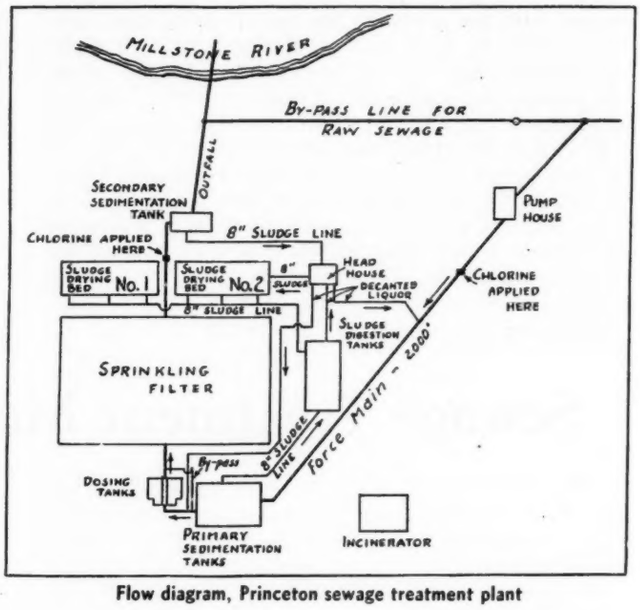
The Digestion Tank

CHLORINE pretreatment at Princeton, N. J., has been very helpful, and Engineer Riker recommends the construction of a small chlorine house "for pretreatment with ferric chloride produced locally through the action of chlorine on tin cans." The experiment was tried out last year of passing chlorine solution through a tank filled with tin cans, which "greatly improved the effectiveness of pretreatment; the resulting solution of ferric chloride did not leave as pronounced a medicated odor as when chlorine alone was used." Chlorine was applied to the sprinkling filter effluent, and a residual of over 0.5 ppm was maintained in the final effluent during the bathing season. The chlorine cost $4.17 per million gallons, of which $1.63 was for final treatment, or sterilization.[H4-1]

Sludge fertilizer is sold by Dayton, O., the prices during 1934 being $1.00 per cwt. for 100 to 400 lbs., 85 cts. for 500 to 900 lbs., 75 cts. for 1,000 to 1,400 lbs., 65 cts. for 1,500 to 1,900 lbs., $11 a ton for 1 to 24 tons and $6.50 per ton for larger quantities. All the sludge is sold, 87½% last year through dealers, and in 1934, 1,187 tons of sludge was sold for $8,589, with a net profit of $1,344. However, the cost to the city is small since the work is done with Federal relief labor. Superintendent Tatlock believes that "sludge can be sold if sufficient effort is put into the undertaking, but the work should be carried on as a side issue to sewage treatment and not as the main enterprise, with sewage treatment producing the raw material for the process. With the proper market, such projects may be made self-supporting if not profit bearing." Dayton has been selling sludge since 1931.

Dayton's sludge is similar to other Imhoff tank sludge except that it runs a little higher than the average in nitrogen—3.95% in wet sludge and 3.82% in dried sludge in 1934. It is dried for an average of 30 days on glass-covered beds to a moisture content of 50% to 60%; being further dried if necessary in a direct-indirect drier made from an old asphalt sand drier, in which the moisture is reduced to 2% to 5%. Before being dried, the sludge goes through a Royer sludge disintegrator which eliminates any tendency of the wet material to ball up during its passage through the drier. It is then ground in a J. B. No. 2 hammer mill equipped with a cyclone blower and sacker, and sacked for sale. Sludge gas is used as fuel for the drier.

The drier cost nothing but setting up, but was extended 20 ft. in length in 1932 at a cost of $1,822 (including stack, shelter and appurtenances); other equipment in 1932 and 1933 cost $1,250; and in 1934 purchase and installation of the Royer disintegrator cost $412, and a cash register, safe and minor equipment $240. Including discarded equipment and the building sheltering the plant, the total capital expenditures have been $4,616. Maintenance expenses in 1934 were $523 for mill parts (including duplicate set of parts for quick replacement), $29 for bearings, $247 for drier repair (the drier was badly damaged by a gas explosion), $217 for labor and $18 miscellaneous. Operating expenses totaled $5,559, of which the largest items were $2,639 for labor, $2,198 for bags and $65 for bag ties, tags and hooks. Power cost $430, water $146, and gasoline and lubricants, $22.[G4-3]



Flow diagram, Princeton sewage treatment plant

Sludge digestion supernatant water at Princeton, N. J., amounted to 96,000 cu. ft. in 1934, and its disposal has proven one of the chief difficulties at the plant. The plant was designed for discharging it into the raw sewage before it enters the primary sedimentation tanks, but one of the recommendations for 1935 is the construction of a tank for the conditioning of supernatant water.[H4-1]

Oil and grease in sewage may amount periodically to as much as 1/3 of the total suspended solids. They are objectionable because of clogging fine screens, floating other suspended matters, difficulty of digestion and giving objectionable appearance to streams receiving the effluent. The only method of removal in common use is skimming from the surface of the sewage, in either sedimentation tanks or special tanks placed ahead of sedimentation tanks. Floatation of the grease is sometimes hastened by aeration, which de-emulsifies the oil and also carries to the surface particles of it which adhere to the small air bubbles.

Removal of oil from the surface is effected by skimming by hand, by skimming devices operated by the sludge-removal mechanism, or by drawing off by lowering a weir or other outlet. Two or three plants have used horizontally acting jets of water to drive the scum to one end of a tank for removal.

Grease and oil removed are buried, incinerated, or digested with other sewage solids, but the last has not proved practicable at some plants. Some places have used the oil on roads.[L4-1]

The B.O.D. test is influenced by the ratio of organic carbon to total nitrogen, according to general belief, but exact relationships are undetermined. Holderby and Lea's experiments indicate that "the rate of biochemical oxidation of an organic waste is strongly influenced by the ratio of the organic carbon to the total nitrogen contained therein, though the ultimate demand probably is not affected. The rate of oxidation is very low with a carbon-nitrogen ratio of 120:1 and tends to decrease slowly at higher ratios. The rate of biochemical oxidation increases rapidly at ratios below 120:1 and the ratio conducive to maximum 5-day oxygen demand is probably in the neighborhood of 5.7:1. [C3-5]

Sewage sludge is combined with pulverized home refuse in Maidenhead, England. Population, 22,000. Refuse averages 110 tons a week, from which is obtained 30 tons of ashes and 10 tons of cans, bottles, rags, etc. The remaining 70 tons is mixed with 35 tons of sludge 97% water, and digested for seven days, giving 50 tons of fertilizer. Cost, including digestion, is 56 cts. a ton, including renewals, repairs, etc.[D3-4]

Combined garbage and sewage, the garbage being added to the sewage in each dwelling, is believed feasible by Mr. Cohn. He answers the questions: Would a simple home disposal unit be practical? (He has used one on all his food for months; but Glenn Holmes doubts whether the housewives would take kindly to it, and the total cost of individual grinding units would exceed a central plant). Would the house plumbing pass the wastes? (Both Cohn and Holmes believe it would, although the latter anticipates more stoppage due to grease). Would the sanitary sewers carry the mixture? (Both agree they would if materials other than food be excluded, such as metal bottle caps, broken bone, egg and oyster shells, china and glass ware). Would the treatment works properly treat the mixture, and what increased capacity would be required? (Mr. Cohn's experiments indicated increased efficiency of sedimentation and no difficulty in digestion except greater acidification. More plant tests are necessary for answering these questions). [C3-6]

Septic tanks are still used in France, it would appear, since a lengthy paper was read by a sanitary engineer before the French Association Generale des Hygienistes et Techniciens Municipaux, explaining in great detail why "gravity separators" or two-story tanks are far superior to septic tanks. They permit the water to leave as free from putrefaction as it arrived, which greatly facilitates biological purification of the effluent and prohibits odors; having a much smaller capacity, they cost less; and the plant for treating the effluent costs very much less. The author, M. Frey, prefers a vertical separator (similar to a Dortmund tank with a digestion chamber in the bottom) as being "technically preferable," although more expansive than the horizontal separator (Imhoff tank); and considers the latter impracticable for "portable domestic apparatus," for which only the vertical separators are satisfactory.[T4-1]

Jacking a 5-foot concrete *pipe* under a railway fill at Rutland, Vt., cost much less than open cut or conventional tunelling methods. "The distance that can be jacked depends on the equipment and the strength of the pipe being pushed as well as the solidity of the backstop. About 50 ft. is obviously the limit under a railroad embankment for a jack capacity of 200 tons and jacking blocks of oak or maple. There is no doubt that the vibration resulting from fast heavy trains keeps the dirt packed solidly around the pipe, thus greatly increasing the frictional resistance." In this case the cost of placing the pipe was $24.91 a foot, the pipe itself costing $7.63 additional.[E4-1]

Sewer pipe support across ground subject to subsidence because of coal mines below, or where firm foundation was at a depth impracticable to reach was a problem in building an outfall sewer from Kilmarnock, Scotland, to the ocean. The sewer was 48″ diameter, and was built of ⅜″ steel pipe furnished in 25′ lengths. For fully a mile across a peat bog and above coal workings these pipes were supported, at 25′ intervals, by a pair of 9″x9″ creosoted pitch pine piles, with 6″x3″ steel channels carrying a timber seat for the pipe bolted between. The piles project 4′ above the pipe invert so that, should the ground and piles settle, the channels which support the pipe can be raised to return it to its gradient. The 25′ lengths of pipe are welded at the joints, except that at 100′ intervals a special joint is provided allowing for contraction and expansion, or for removing a section for repairs or other reason.[D4-2]

Bibliography of Recent Sewerage Literature

To find an indicated reference, find the given letter and bold-face number at the left of the column, and the light-face number (following the dash) immediately below this. The bold-face number indicates the month of issue of Public Works in which the article was listed, which is generally the current but may be a previous one.

c, Indicates construction article; *n*, note or short article; *t*, technical article.

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Solving a Problem in Street Drainage

By Fred X. Conrad
City Engineer, Port Jervis, N. Y.

IT IS unfortunately true that most small sewers do not get the attention in design that they should have. It is obviously wrong to say that a small sewer is not important. It is a fact that large sewers, when improperly designed, will cause extensive and costly damage; but it is the small sewer which is most often a continual source of complaint from the taxpayers, householders, etc. If it is insufficient in size, or the catch-basins too few in number to keep the street from flooding periodically, it brings a continuous line of disgruntled residents to the city hall.

Port Jervis is one of those numerous cities in which storm drainage problems are intensified by the topography. The business portion of the city along the Delaware river is flat, but beyond this are steep slopes bringing large volumes of storm water to this flat area.

Fowler St. is one of the important thoroughfares running away from (and perpendicular to) the river. When it was decided to repave this street with concrete, it was not a difficult job, in view of previous troubles from lack of drainage, to "sell" the idea of a new sewer to the Mayor and Common Council.

Design Factors

In planning adequate storm drainage, many factors must be considered, since it is not possible to design only for the drainage of the street in which the sewer is to be laid. There are not only such important items as grades, the intensity of rainfall, degree of imperviousness of the area to be drained, but also the drainage of the entire area which, by reason of topographical conditions, will contribute storm water to the street.

Field Work

As is the case in many cities that are much larger than Port Jervis, data were initially lacking for design. A complete topograpical map of the city is being prepared as an unemployment relief project, but the area involved in the Fowler Street project was not yet mapped. Accordingly a field party made a complete survey of the project. Center lines were run on Fowler Street and on all other streets likely to contribute water to the sewer, and from these center line surveys (with the collection of some additional data in certain areas), cross-sections were taken and a contour map made. From this it was possible to determine all areas draining to the main line down Fowler Street.

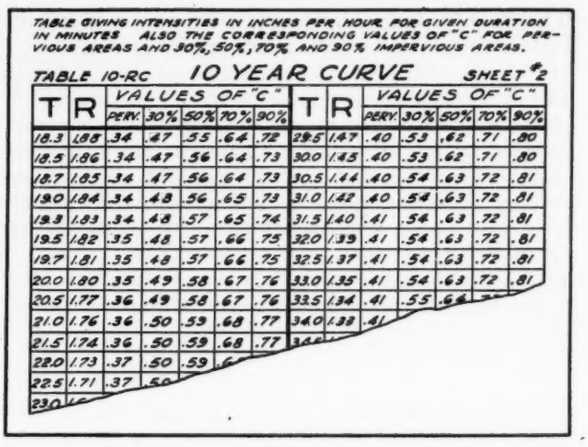

TABLE GIVING INTENSITIES IN INCHES PER HOUR FOR GIVEN DURATION IN MINUTES ALSO THE CORRESPONDING VALUES OF "C" FOR PREVIOUS AREAS AND 30%, 50%, 70% AND 90% IMPERVIOUS AREAS.

TABLE 10-RC 10 YEAR CURVE SHEET #2

T	R	VALUES OF "C" PERV.	30%	50%	70%	90%	T	R	VALUES OF "C" PERV.	30%	50%	70%	90%
18.3	1.88	.34	.47	.55	.64	.72	29.5	1.47	.40	.53	.62	.71	.80
18.5	1.86	.34	.47	.56	.64	.73	30.0	1.45	.40	.53	.62	.71	.80
18.7	1.85	.34	.47	.56	.64	.73	30.5	1.44	.40	.54	.63	.72	.81
19.0	1.84	.34	.48	.56	.65	.73	31.0	1.42	.40	.54	.63	.72	.81
19.3	1.83	.34	.48	.57	.65	.74	31.5	1.40	.41	.54	.63	.72	.81
19.5	1.82	.35	.48	.57	.66	.75	32.0	1.39	.41	.54	.63	.72	.81
19.7	1.81	.35	.48	.57	.66	.75	32.5	1.37	.41	.54	.63	.72	.81
20.0	1.80	.35	.49	.58	.67	.76	33.0	1.35	.41	.54	.63	.72	.81
20.5	1.77	.36	.49	.58	.67	.76	33.5	1.34	.41	.55	.64		
21.0	1.76	.36	.50	.59	.68	.77	34.0	1.33	.41				
21.5	1.74	.36	.50	.59	.68	.77	34.5						
22.0	1.73	.37	.50	.59	.6								
22.5	1.71	.37	.50										
23.0													

Fig. 1—Rainfall intensities for given durations in minutes. Also corresponding values of "C"

The key map shows the general layout, while the large map shows the division into drainage areas. An existing sewer drained the area shown in the upper left portion of the map (John, Elizabeth and Broome streets) but it was necessary to determine how much water would be derived from this area, since the flow is to be carried by the new line from MH6. Therefore the same data were secured for this area as for all other sections of the drainage area. In the map, all areas marked 1, drain into Manhole 1; all areas shown as 2, drain into Manhole 2, etc.

The remaining field work consisted of that necessary to estimate the relative imperviousness of the various areas. The area of roofs, garages, outbuildings, driveways, etc. were determined, as well as lawn areas. An imperviousness factor of .85 was selected for streets, sidewalks, driveways, roof areas, etc.; and of .10 for lawns and gardens, and the areas of each determined.

Office Work

With the map prepared, and the field data regarding imperviousness at hand, design work was begun. As the sewer from MH1 to MH6 was already in existence, it was necessary only to determine the flow from this area. It was decided to design on the basis of a 10-year rainfall. We used this because we felt that probable drainage from an unusual storm of greaterintensity would not be great enough to warrant the extra cash for providing for a 25-year or 50-year storm.

The values of "C" (coefficient of runoff) for the various rates of rainfall are adapted from various sources, since there are no reliable long-range rainfall records in our city. However, from a study of existing data, curves for C and rainfall rates have been adopted which correspond closely to values used in Los Angeles (See Public Works, June 1934). Fig. 1 shows a section of the 10-year tables on which this design was based.

Fig. 2. shows the computations for the design. Column 2 shows the areas, with the degrees of imperviousness.

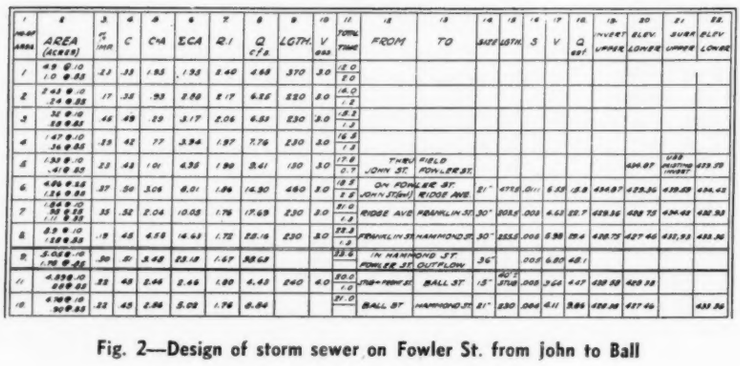

Fig. 2—Design of storm sewer on Fowler St. from John to Ball

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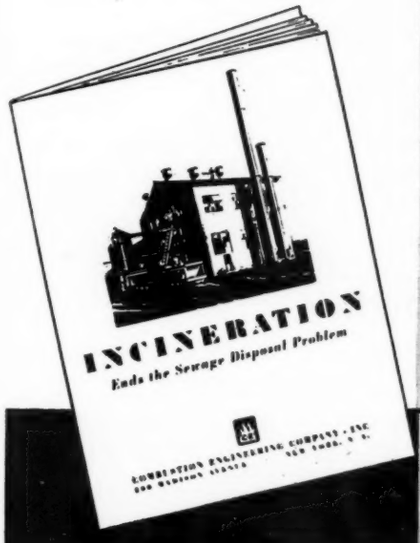

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For your information I have checked the questions below.

We have a sewage treatment plant ☐
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We are planning a sewage treatment plant ☐
We are extending a sewage treatment plant ☐
Our plant produces, or will produce, digested sludge ☐ activated sludge ☐ chemical sludge ☐
Sewage output of our community or project amounts to..... gallons daily.

***Name*.....*Title*.....**

***Address*.....**

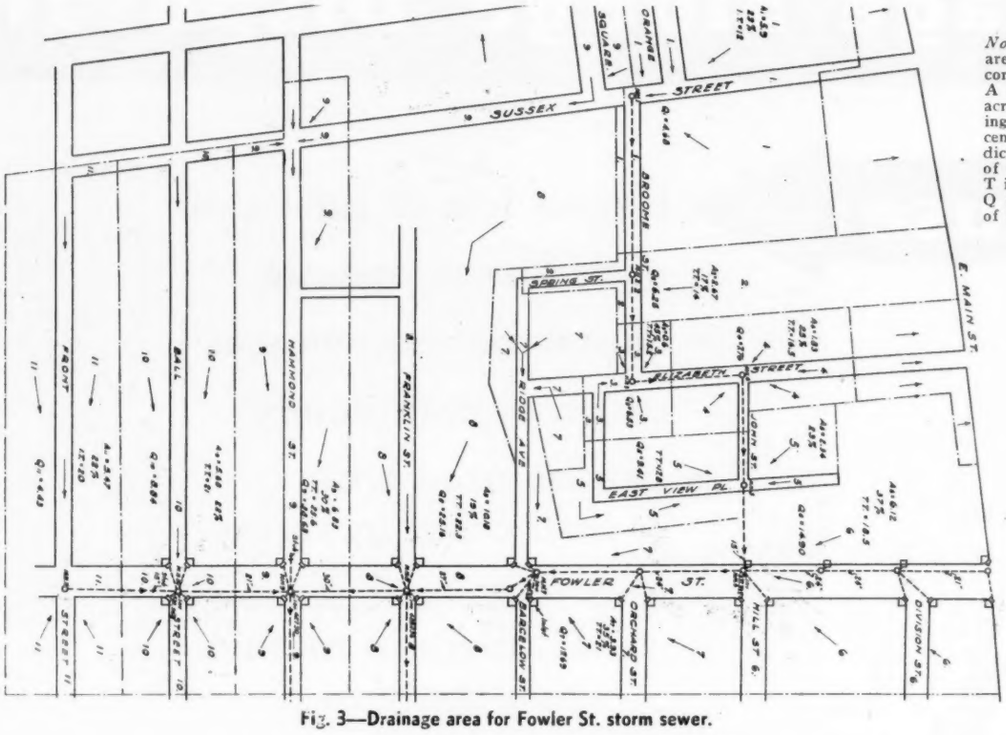
***Company*.....**

Have you looked over the booklets described on pages 47, 48 and 52?

2 shows the areas, with the degrees of imperviousness. Column 3 shows the percentage of imperviousness for the entire area, that is (4.9 x .10) + (1.0 x .85) ÷ (4.9 x 1) = .23, which is the average imperviousness for the entire area in 1. The time of concentration for area one was determined by observation during a rain and by computation of gutter grades, is 12 minutes. For T of 12 minutes and imperviousness 0.23, the coefficient of runoff is read from the table, and the value is found to be .33. The fifth column shows the area under consideration; the sixth column the total area contributing to the sewer. The rainfall intensity on the 10-year curve, for a time of 12 minutes is 2.40 inches. The product of columns 6 and 7 gives the flow in cubic feet per second.

The actual design of the sewer starts at MH6, and at this point the volume of flow is 14.90 cubic feet per second, which amount must be carried from MH6 to MH7. The distance is 477.5 feet, and the slope is .0111. This gives a velocity of 6.55 feet per second, and a capacity of 15.8 cubic feet per second, when using a 21-inch pipe, which is satisfactory. Invert and ground elevations are also shown.

The required capacity increases down to Hammond Street, where is an outfall built several years ago. The theoretical size for the Hammond Street sewer is 36 inches, but the size of the present line is 27 inches. However, there is an 18-inch overflow sewer at Franklin Street, which provides the required capacity.



Note: Numbers indicate areas draining to manholes correspondingly numbered. A sub gives total area in acres of drainage area bearing that number. Percentages given are those indicating the imperviousness of the area.
T is time of concentration, Q is accumulated quantity of flow, in cu. ft. per sec.

Fig. 3—Drainage area for Fowler St. storm sewer.

Relaid Brick Gives Economical Surface

By B. H. Platt
Village Manager, Wilmette, Ill.

DURING the period of CWA activity we relaid approximately 40,000 square yards of brick pavement. These brick were originally laid on a macadam base with a sand cushion approximately two inches thick, and the joints were sand filled.

In relaying the brick it was necessary to remove them from the street and clean them. The old sand cushion was loosened by means of rakes and a small amount of sand added which, after striking off and rolling, gave a thickness of sand cushion ranging from one-half inch to one and one-half inches. Apparently a considerable amount of the original sand cushion had been washed out by the rain and carried away in the gutter.

On account of limited funds for the purchase of materials we were unable to use any filler for the joints, and we, therefore, used sand. Fortunately we are situated on the shore of Lake Michigan where we have an unlimited supply of beach sand which costs us nothing.

The cost of this work under CWA ranged from 32 cents to about 60 cents per square yard, the higher price being caused by the fact that the work was carried on through the winter months when the brick were sometimes frozen solid and it was necessary to thaw out the brick and the sand cushion with torches.

Replacement with new brick ran about 7 per cent. Prior to the CWA work we did some work similar to this, hiring our own labor. This work cost us in the neighborhood of 35 cents per square yard and was done on a street on which the original brick were of the lugless type. In relaying these brick, they were turned on their sides, and there was sufficient gain in area to make up for the broken brick which had to be rejected. On most of the work done by the CWA the brick were of the lug type, which were unsatisfactory when placed on their sides.

We anticipate doing additional work of this nature in the coming season, using labor furnished by the Emergency Relief Administration and funds for material from our share of the State gasoline tax. In this season's work we intend to remove the old sand cushion entirely and to replace it with a mastic cushion and also to use an asphalt filler for the joints.

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***WHATEVER** system of sewage treatment you have . . . or are planning . . . it will operate more effectively and at lower cost with the Laughlin Filter!*

At the right you see the raw sewage entering the Laughlin Filter—in the center, the effluent, so clear that the full depth of the side walls is visible.

- The Laughlin Filter fits into any system of sewage treatment and gets results not otherwise secured in that system.
- It removes suspended solids—positively and economically—and delivers a well-clarified effluent.
- Applied to the settling basin to remove more and finer settleable solids, it yields such advantages as are quoted at the right.
- Only large and settleable solids can be removed by bar screens, fine screens or settling basins.
- In cases not requiring nitrification, the Laughlin Filter will displace trickling and sand bed filters—or reduce the load and increase the capacity of those filters. It also practically eliminates the fly and odor nuisance and pooling.
- The Laughlin Washer has few moving parts, washes the bed automatically as required and *permits continuous operation of filter without attention.*
- Power requirements are low. Head loss is less than 3″. Can be applied to existing tanks, either circular or rectangular.
- Investigate what is being accomplished in the chemical-mechanical plant at Dearborn, Michigan. Watch for the results of the experiments at Chicago, where the Laughlin Filter is added to an Activated Sludge plant—and at Coney Island, where it supplements Plain Sedimentation—and in other tests where it is added to and improves Chemical Precipitation. See the new plant soon to be put into operation at Perth Amboy, New Jersey.
- Four years of continuous testing and improvement permit us to furnish engineers with authoritative data which can be safely used as a basis for design. Write us for information.

With PLAIN SEDIMENTATION

. . . the Laughlin Filter increases removal of suspended solids from 40-50% to 65-70% *without the use of chemicals*—and steps up capacity without adding more clarifiers.

With CHEMICAL PRECIPITATION

Increases removal of suspended and colloidal solids from 70-80% to 90-95% with the same amount of chemicals—or reduces amount of chemicals required. Greatly increases flexibility of plant to meet daily or seasonal variations.

With ACTIVATED SLUDGE

Removes floc not settled out in final tank. Installed in primary tank, it cuts down load on aeration tank. Safeguards stream during temporary overloads or biological disturbances, until plant can be brought under control. Reduces aerating period—amount of air required—or both.

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Have you looked over the booklets described on pages 47, 48 and 52?

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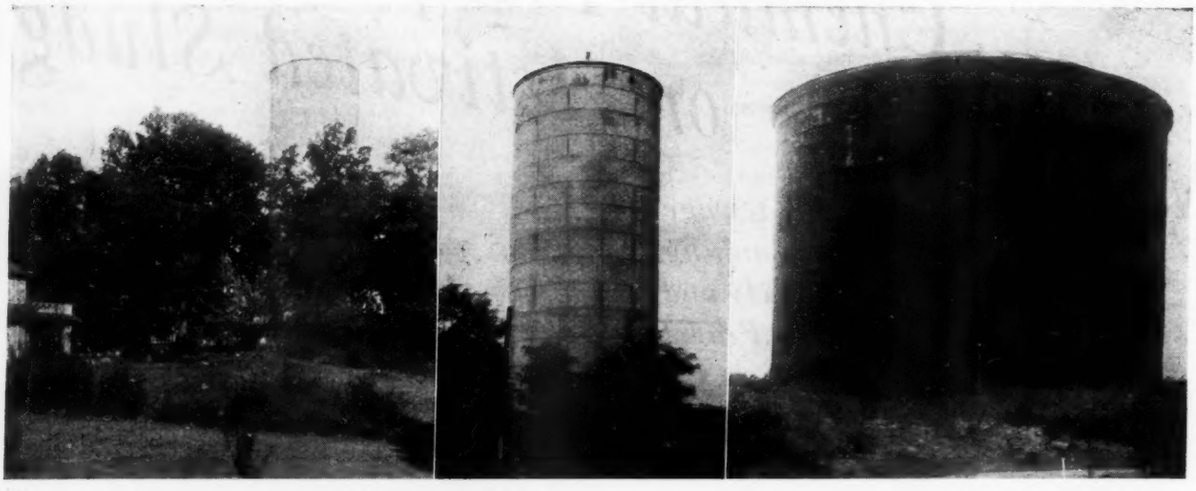

A good paint job: a uniform gray giving pleasing appearance.

Painted before mill scale was removed. Note dark spots at top and at seams.

Standpipe after weathering for 16 months without paint. Small light patches in upper part show remaining mill scale.

Treatment of Mill Scale on Water Tanks and Standpipes

By Carl A. Hechmer

Department Engineer, Washington Suburban Sanitary District, Hyattsville, Md.

IT is not unusual, in fact it is general practice, in the erection of standpipes and elevated tanks, to contract for the painting of the structure along with the erection, the same contractor performing both jobs. The design of the foundation and steel work is given minute attention to insure the safety of the structure, and the paint to be applied, both priming and finish coats, is selected with great care in order that the structure after erection will present, especially in residential sections, a good appearance. However, little attention has been given the question of the preparation of the steel to insure a good painting job, one that will last from three to five years, adequately protecting the steel from the elements and, if proper consideration is given the surrounding landscape in the selection of colors, presenting a pleasing appearance to the public.

All steel when fabricated attains a coating of mill scale which is almost impossible to remove unless given special treatment, and the removal of this mill scale is what is meant by preparation of the steel to insure a good paint job. If covered by paint, the scale will sooner or later become loose from the steel due to oxidation. and as the paint film becomes completely oxidized and thins down from chalking, the mill scale will fall off the steel surface and carry with it the remaining paint film. The complete removal or oxidation of the mill scale at one time under a film of paint is never possible, however, as oxidation of the scale will be slow in places where the paint has been applied thickly, and rapid where the paint film is thin. Two men painting a tank will not apply the same thickness of paint and this will result in the mill scale falling off in patches.

The writer has knowledge of one standpipe which was painted without treatment for the removal of mill scale. The parts of the structure painted by one painter could readily be distinguished from those covered by another painter. A light colored paint was used and the thicker films of paint oxidized more slowly, delaying the separation of the mill scale from the steel. Unfortunately, when a standpipe in this condition is repainted the mill scale is removed from the sections where the paint film is thin, but the mill scale is still tight under the thick paint and is not removed by the wire brushes and scrapers. In another year or two some of the remaining mill scale becomes loose and again the structure must be painted. This time the surfaces from which the mill scale first was removed hold the paint tightly and receive another application of paint. Thus, it will be readily understood, parts of the surface will receive repeated applications of paint on surfaces free of scale, while other parts, from which scale has not sloughed, will also be painted and repainted. The various applications of paint on surfaces of various stages of oxidation show different depths of color when oxidation begins. Consequently the structure never will present a uniform appearance if any color but black is used, and the present day tendency is toward light colors in painting steel water works structures. Also the surface of the structure becomes rough and uneven.

Aside from the appearance of the structure, the seri-

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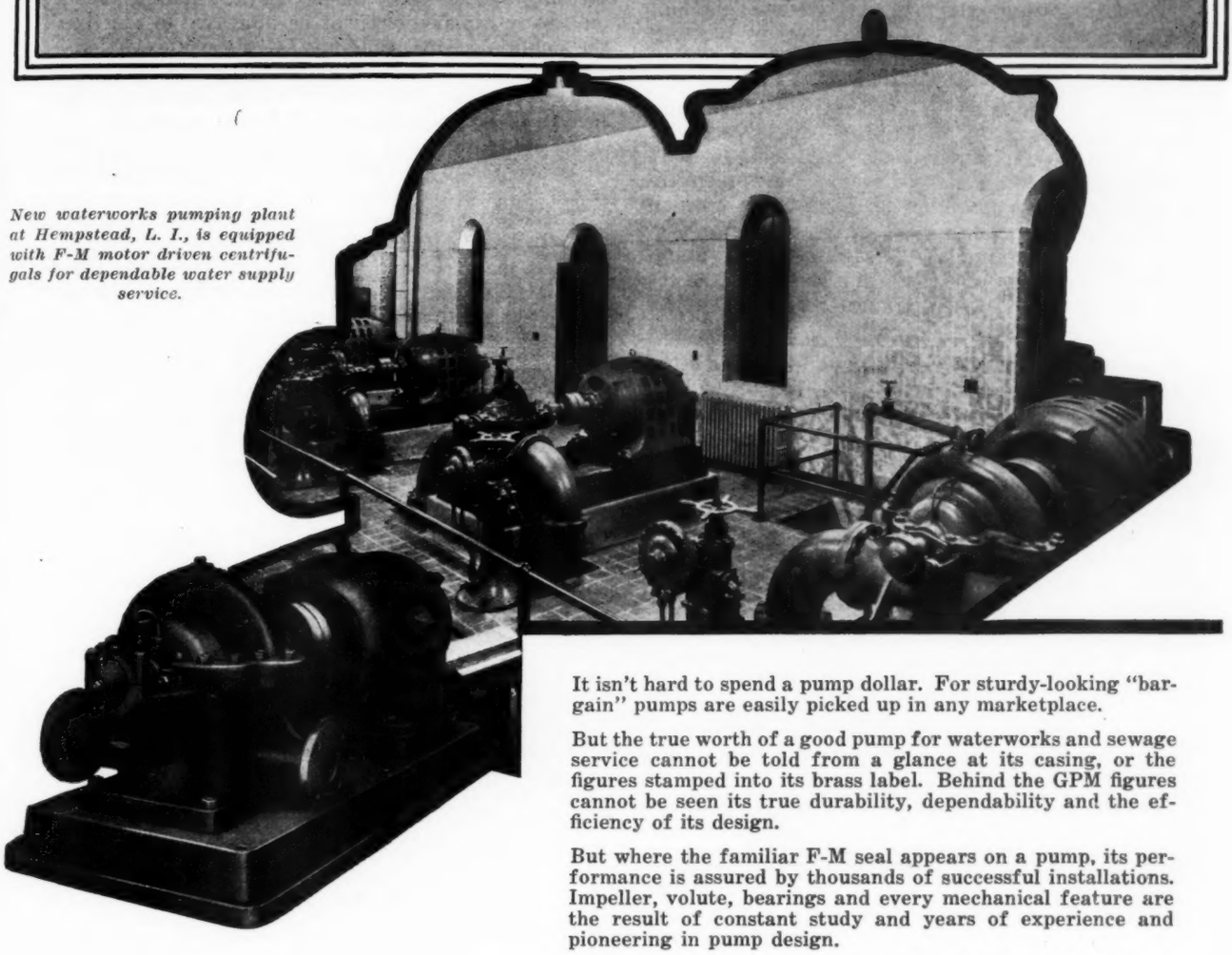

New waterworks pumping plant at Hempstead, L. I., is equipped with F-M motor driven centrifugals for dependable water supply service.

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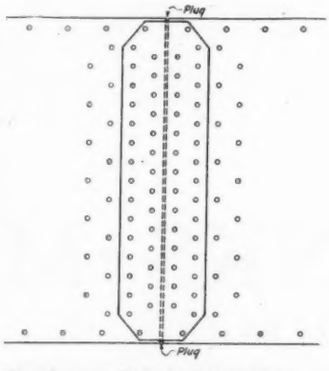
ous question of adequate protection of the steel must be considered. As the mill scale becomes loose and falls off the surface, carrying the paint with it, the bare steel is exposed to the weather and rusting and pitting will occur. The paint film surface is broken and oxidation takes place behind the paint, further hastening the separation of the mill scale and thereby eventually exposing larger surfaces. Water also gets behind the paint surface, causing damage to the steel even where mill scale has previously been removed.

The removal of mill scale can be effected in a number of ways, leaving a clean steel surface for application of paint. Weathering the steel plates at the mill before shipment or treatment of the steel by pickling with acid are two methods that might be employed. However, the former would require an enormous storage yard, making difficult the keeping of the large quantity of steel of the proper specifications necessary to meet the varying requirements; and treatment with acid would, in addition to being expensive, interfere with the proper application of paint after erection unless a second treatment were given the steel to neutralize the acid. Sandblasting after erection will remove the scale, but this method is expensive, as the scale, being very tight, is difficult to remove.

The most effective as well as the most economical method is to omit the usual shop coat of paint and allow the entire structure to remain unpainted for at least six months, preferably twelve months, after erection. By this time practically complete oxidation and sloughing of the mill scale is effected and the scale still clinging to the steel can easily be scraped off or brushed off with a wire brush. After the removal of the mill scale. the steel will be most satisfactorily cleaned by sandblasting, but good wire brushing will insure an excellent paint job and complete protection of the steel if sufficient time has elapsed since erection. On the Capitol Heights standpipe, in the Washington Suburban Sanitary District, mill scale started to fall off within six weeks after erection was completed. After weathering 16 months more than 95 per cent of the surface was practically free of scale and that remaining was so loose it could be removed with a pocket knife. Wire brushing removed the very thin rust film on the steel, no pitting or excessive rust formation appeared, and an excellent painting job resulted.

The mill scale in the overlaps at the joints, of course, cannot be removed if the tank or standpipe is erected before the scale is removed from the steel. This scale will probably remain on the steel but will do no damage nor in any way affect the structure. The overlap at the joints should be sealed as completely as possible by welding, or made tight by the injection of small lead plugs as shown on the attached sketch, to protect the inner steel surface from the weather. Sloughing of mill scale in an open joint will allow the formation of rust, since it is impossible to paint behind the joint and rapid deterioration of of the steel will take place. On structures painted in light colors, the water coming through the joints will carry rust streaks to the steel plates below and seriously mar the appearance of the tank or standpipe. Proper covering of the outer surface, completely sealing the joints, will adequately protect the structure, since oxidation can take place only through the paint film, and the steel under the joints will receive as much protection as the outer surfaces of the plates; the inner surfaces, of course, having no contact with the atmosphere.



Showing method of sealing joints to prevent rust streaks from appearing below joint and protect metal plates at joint.

There is one objection, however, to the foregoing method, and that is the structure will be anything but pleasing in appearance during the weathering period, and many explanations will be necessary to convince the public that the standpipe is being properly protected. Residents in the neighborhood will object to its rusty appearance, but when it is explained that a few months of bad appearance will insure a permanent good appearance they usually agree with the water department that good judgment is being shown in the maintenance of the standpipe.

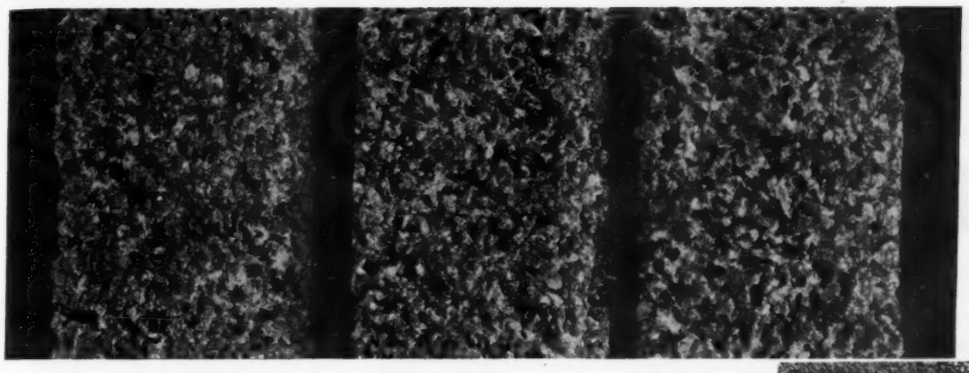
The selection of proper paints is also of paramount importance if a lasting job is to be obtained. While it is not the purpose of this article to discuss the relative merits of lead and oil paints as compared with the newer synthetic resin paints, the writer's experience has been that the latter are very satisfactory on large and small metal structures varying from standpipes and elevated tanks to fire hydrants. Chalking of the synthetic paint has been considerably less than when using lead and oil paints and we have adopted the former as standard on all our structures of these types.

Preventing Ice Jams

An unusual method which proved entirely successful was used in breaking up the ice and thus preventing ice jams in the Raritan River near New Brunswick, N. J., during February. Instead of waiting for the ice in the river to break and thus cause piling up with consequent damage, it was determined to blast the ice in those parts of the river where ice jams usually occur. It was believed that if this could be done successfully, the flow of the river would carry away accumulations of ice without danger to industrial factories and dwellings.

The work was under the supervision of the Board of Commerce and Navigation of New Jersey. L. C. Longstreet did the blasting, assisted by a crew of three men.

The ice at the danger points in the river, where ice jams usually form, was shot first, thus weakening it. Next, short channels were shot between these danger points so that when the cracked and weakened ice began to move it would have a pathway and could float away. As a matter of fact, when the ice movement started the masses of drifting ice which were forced down the blasted channel drove against the sections of ice which remained at various points, and which had already been weakened by the dynamite blasts, and shoved them aside towards the banks. These masses of ice which were shoved aside were in their turn blasted again, sometimes by cutting holes and placing the dynamite in them; or, if difficult to reach, by throwing the dynamite with the fuse lighted upon them thus breaking them up. In this way there were no jams of long duration and the river was cleared for a distance of six miles in 24 hours. A blasting machine, 1,000 lbs. of 40% dynamite, 500 electric caps, 100 feet of fuse, and 100 blasting caps were used on this job.



LEFT: Magnified sectional view of three Norton Porous Plates made of grains that are alike in size but differently spaced to give different permeabilities.

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CORRECT permeability is the keynote of porous medium success. Plates and tubes must have the right permeability for their particular job and it must be uniform from plate to plate or tube to tube.

The permeability of Norton Porous Mediums is varied by two methods: 1. By using different size grains of fused alumina (right hand illustration); 2. by using grains of the same size and changing their spacing (top illustration). In both cases the Controlled Structure process of manufacture is used—a process developed and patented by Norton Company.

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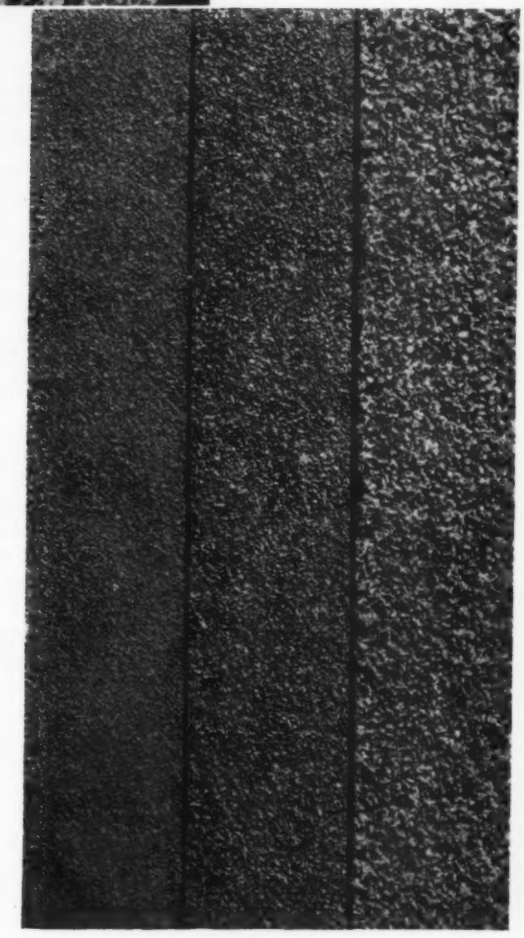

ABOVE: Three Norton Porous Plates whose difference in permeability is obtained by varying the size of the grains of fused alumina.

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Have you looked over the booklets described on pages 47, 48 and 52?

Following is a digest of the important articles published last month having to do with water works design, construction and operation and water purification, arranged in easy reference form.

The Water Wheel

DROUGHT conditions in S. Dakota, Iowa and Kansas, as described by the engineers of their respective State health departments, are not as serious as early reports indicated. S. Dakota was the worst hit; the James river, the largest in the eastern part of the State, went dry, as did most of the other rivers and 15 of the most important lakes. Cities disposing of their sewage by dilution are in serious difficulty. Most shallow wells went dry. But a very large number of flowing wells draw about 7 mgd. from the Dakota sandstone. During the drought some of these were temporarily drawn upon beyond their normal capacity and the resulting trouble was widely reported as evidence that even the most reliable sources are failing. But in many instances wells were reclaimed by cleaning and drilling a few feet deeper. The general water level has been reduced only 7 to 30 ft. and this will probably make up at the end of the drought.[A4-1]

In Iowa there was comparatively little trouble with ground water supplies except shallow ones in loess and local gravel pockets. Most of the trouble was with impounded supplies, the surface streams going dry and the storage being inadequate; the latter being aggravated by the fact that, owing to the State's topography, reservoirs are generally shallow (averaging about 10 ft. deep) and evaporation losses excessive. Last year's experience "has shown that in southern Iowa storage equal to the consumption, evaporation and percolation for periods of more than a year is necessary unless auxiliary supplies of ground water are available." [A4-2]

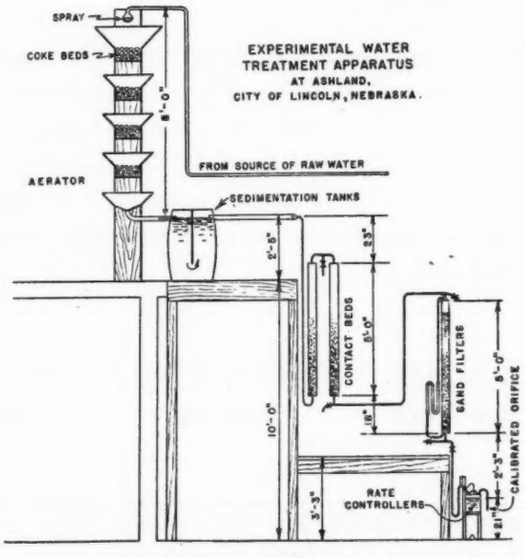
In Kansas, in general, the municipal water supplies were not seriously affected by the water shortage. "Increased storage, however, has been shown to be desirable, not only to ensure public supplies but also to retard flood flow of streams and provide a continuous flow in them for the dilution of sewage and industrial wastes." However, "due to the high evaporation rate in western Kansas, it is especially important that subsurface rather than surface storage be developed as fully as possible," for which purpose irrigation runoff water is spread over water storage formations; which may also be aided by terracing and ponding for soil conservation.[A4-3]

Anthracite as a **filter medium** has been used by the Denver, Colo. Water Works for ten years For the last four years the average rate of filtration has been about 160 mgd. per acre—28% more than the normal rate with sand. Last year they tried 6″ of coal on 14″ of sand, the former 0.8 mm. size, the sand 0.52 mm. with 1.72 uniformity coefficient, from which it appeared that this combination gave as good clarification and bacteria removal as sand alone, with longer runs, higher rate of filtration and less wash water. Superintendent Ripple finds from his experience with anthracite, both alone and with sand, "that it is a very excellent filter material and one which should, in my opinion, receive more attention from designers and operators of filter plants," but only the hardest coal, such as Pennsylvania anthracite, should be used.[F4-9]

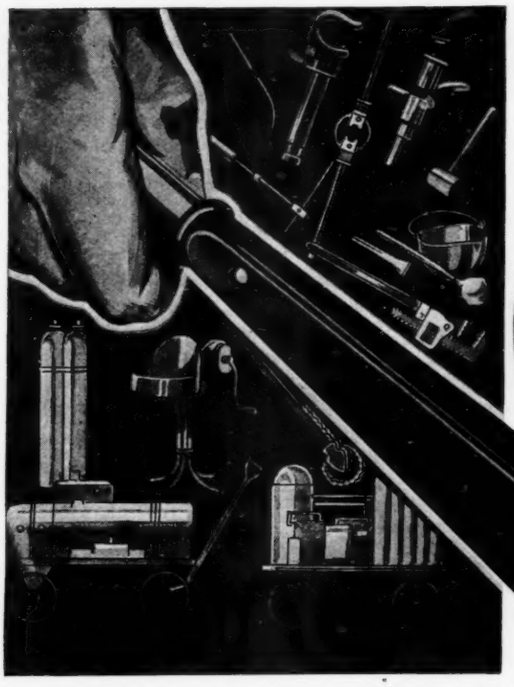
Manganese and iron removal from the new Lincoln, Neb., water supply will be effected by a plant (see *Water Wheel* for March) whose design was based on an experimental plant, operation of which began in January 1934 and is still being continued. This consisted of several parallel systems providing for aeration, sedimentation, contact filters and rapid sand filters. The first consisted of 4 trays filled with coke placed one above the other. Sedimentation was in wooden barrels. Contact and rapid sand filters were made of pyrex glass tubes about 2″ diameter and 5′ long, filled with coke, pyrolusite, gravel, and a combination of the first two. Some of the final sand filters were filled with Ottawa sand, others with Platte River sand.

From these experiments its was concluded that aeration rates up to 4 gpm. per sq. ft. gave satisfactory CO_2 removal and up to 90% saturation of oxygen. Pyrolusite gave satisfactory manganese removal. but required frequent cleaning. Coke gave about the same results as gravel. There was no benefit in sedimentation if prechlorination was used. Final sand filtering up to a rate of 4 gpm. per sq. ft. was entirely satisfactory. Very satisfactory iron and manganese removal was secured by adding 2.5 gr. per gal. of lime followed by 2 hrs. of sedimentation and final sand filtration; or by aeration, chlorination, upward flow through either coke, gravel or pyrolusite, 2-hour sedimentation and rapid sand filtration.[A4-17]

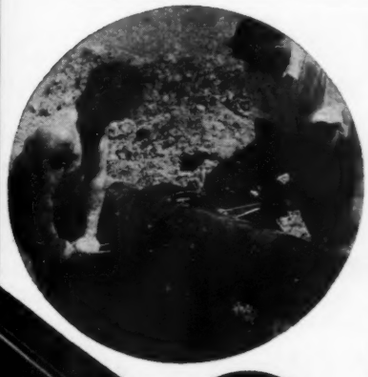
Asphalt road washings do not contain any of the so-called "phenolics" and objectionable tastes and odors will not result from chlorinating water containing such washings. All fractional distillations of tars contain sufficient "phenolics" to cause objectionable tastes and



Experimental apparatus at Lincoln



How Many Tools Does It Take to Make a Joint?



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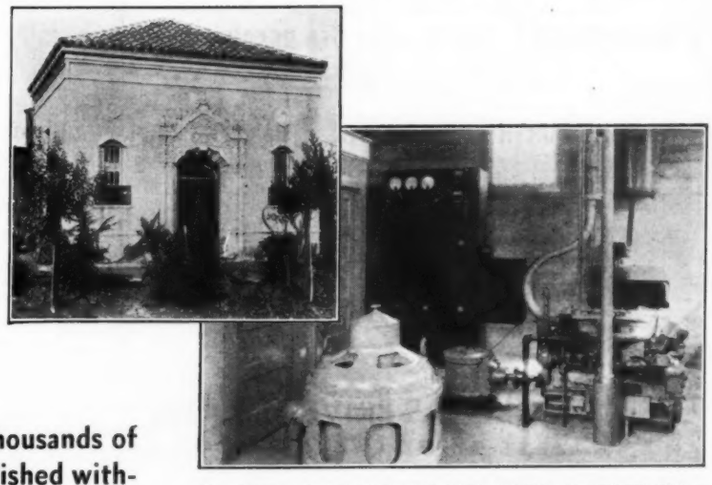

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odors in washings from tar roads. It seems practicable to form a cut-back tar using fractions from which the objectionable tar acids have been eliminated by neutralization or extractions. Road tar specifications should specify a low phenol content; Belgium allows 5 percent. A more exact measure of the total "phenolics" or taste-producing compounds is given by the bromination method than by Baylis' modification of the Gibbs' method.[A4-8]

Underground corrosion causes loss of perhaps $150,000,000 a year. Probably more than seven billion dollars worth of ferrous pipes are exposed to it. The amount and kind of corrosion of ferrous material (iron, steel, etc.) depends much less on the character of the material than on that of the soil. The rate of corrosion after a pipe has been exposed to soil for several years is considerably less than for the first period of exposure. In some soils corrosion takes the form of isolated pits with sharp margins; in others, that of rather large shallow depressions with no well defined boundaries; and these differences are the same, whatever the ferrous material—steel, wrought iron or pure open-hearth iron. "Only a small percentage of the soils of the United States are severely corrosive, but the individual corrosive areas are small in extent and widely distributed. . . . The major cause of the corrosion seems to be nonuniformity in the distribution of oxygen and moisture along the surface of the pipe line."

Copper and high copper alloys resist nearly all soils better than ferrous materials. But as life of pipe increases with thickness of shell, in some cases "it may be better engineering to provide extra wall thickness rather than to invest in corrosion-resistant materials or protective coatings."

Galvanizing and lead coatings of steel pipe deteriorate slowly, but in some soils surely. Even so, they are worth while if the annual cost during the duration of useful life is less for them than for shorter-lived uncoated pipe. Bituminous coatings have not been inspected long enough to learn their life; but failures of them are usually due to abrasion in handling and covering, which abrasion it may be very difficult to avoid. A method of treating coated pipes has been developed which, under favorable conditions, protects the abraded parts. This, known as cathodic protection, consists in maintaining a negative charge in the pipe line with respect to the adjacent earth by means of a superimposed current supplied by a rectifier. If the coating is impervious to moisture and has not been broken in too many places, an inexpensive amount of current may prevent corrosion.[K4-1]

Bibliography of Recent Water Works Literature

To find an indicated reference, find the given letter and bold-face number at the left of the column, and the light-face number (following the dash) immediately below this. The bold-face number indicates the month of issue of Public Works in which the article was listed, which is generally the current but may be a previous one.

c, Indicates construction article; *n*, note or short article; *t*, technical article.

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4. An Analysis of Unusual Precipitation Records in Iowa. By F. T. Mavis and J. W. Howe, pp. 174-190.
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1. City Water Supply from Bottom of 100-Foot Shaft, pp. 51-52.
2. Parker Dam to Furnish Water for 13 California Cities. By K. H. Grayson, pp. 59-60.
3. Water Rates and Service Charges: 12 Cities, pp. 71, 73, 75.

K 4 *Proceedings, Am. Soc. of Civil Engineers*
March

1. Underground Corrosion. By K. H. Logan, pp. 317-331.
2. Seepage Under Dams: On Earth Foundations. Discussion by D. J. Herbert, A. Casagrande and C. V. Davis. On Sand Foundations. Discussions by H. H. Hatch, D. J. Herbert, C. A. Mockmore and J. W. Dougherty, pp. 361-381.

M 4 *Canadian Engineer*
March 5

1. Extension to Water Works System at Watrous, Sask. By T. B. Borgford, pp. 5-6.
2. Deep-Well Water Supply for David Dunlap Observatory. By J. Shortreed, pp. 11-12.

March 19

3. Operation of the Water Purification Plant at Saskatoon. By B. P. Scull, pp. 5-8.
4. Improvements to Kitchener Water Works System, p. 15.

P 4 *Public Works*
March

1. Ground Water as a Source of Public Water Supplies. By L. K. Wenzel, pp. 12-14.
2. Elements of Coagulation for Water Filtration. By Geo. D. Norcom, pp. 27-28.
3. Studies in Water Consumption: So. Central States, p. 29.

This man is pouring

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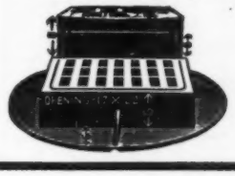

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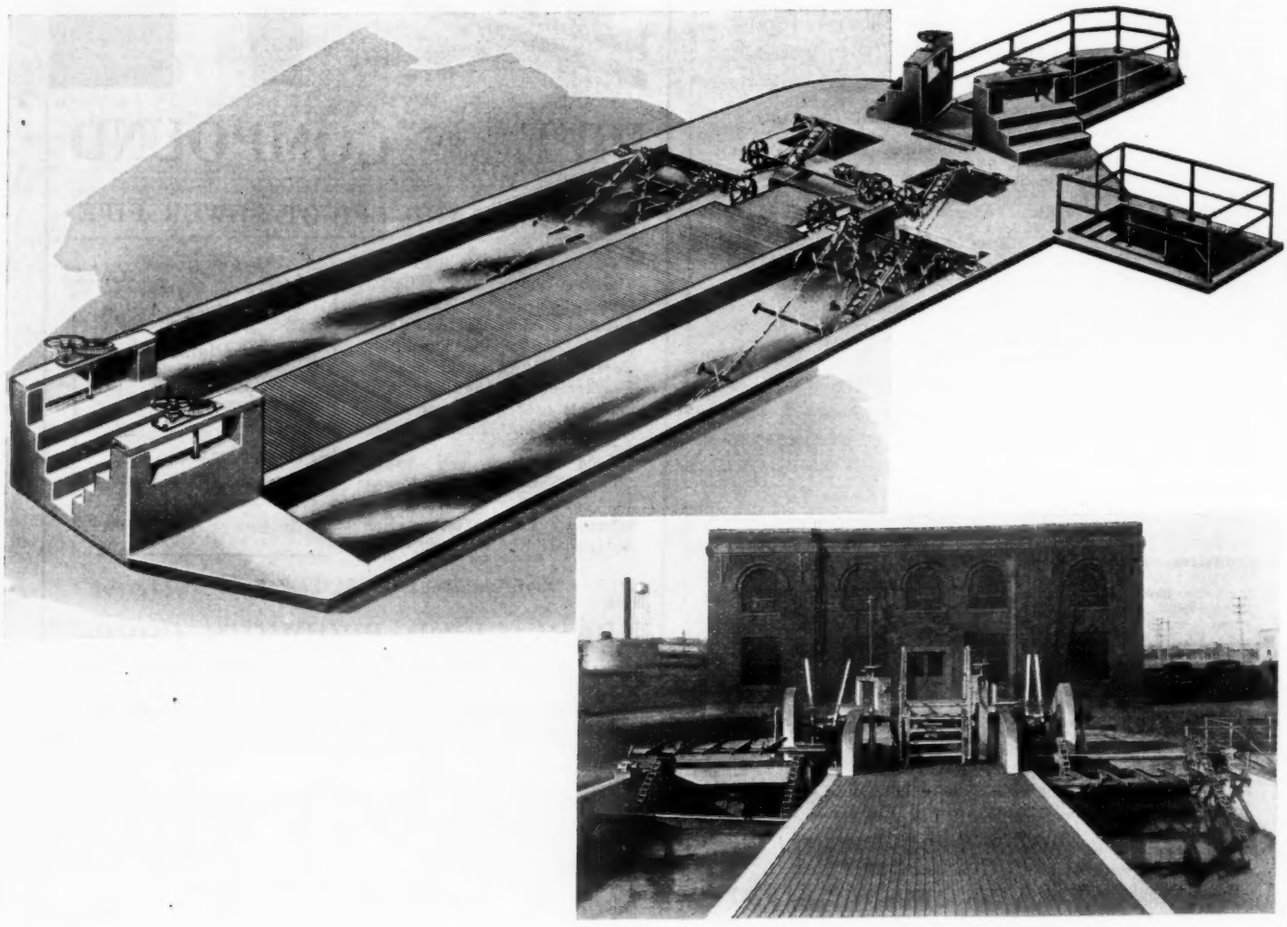

KEEPING settling tanks free of sand and grit is effectively and economically accomplished with Link-Belt Straightline grit chambers.

These illustrations show two Link-Belt Straightline chambers installed at the Peoria, Illinois, Sewage Plant (Greeley & Hansen, Consulting Engineers). The collectors carry the grit and heavy organic matter to an inclined screw washer. The organic material is separated from the sand and grit by this washer.

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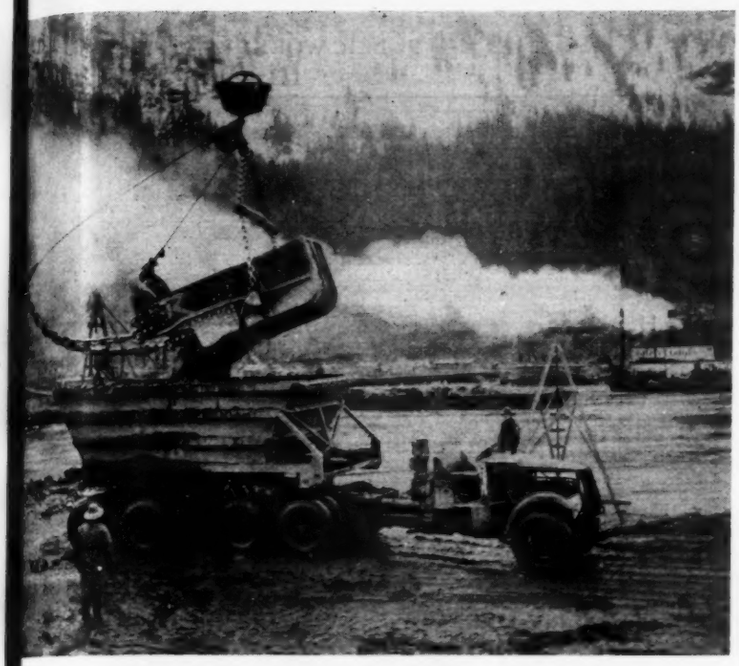
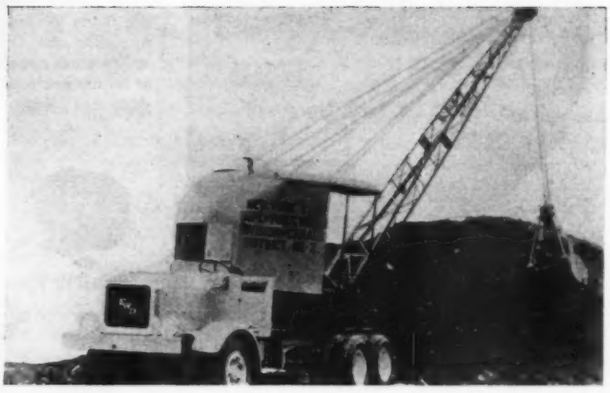
Have you looked over the booklets described on pages 47, 48 and 52?

New Equipment in Pictures

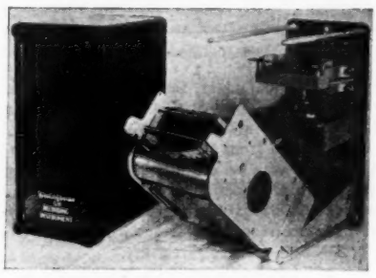


WORLD'S LARGEST DUMP TRUCK UNIT

Even surpassing the 16-yard monster Macks that worked at Boulder and San Gabriel is this Mack unit working at Bonneville Dam, the $32,000,000 power and navigation project on the Columbia. Sixty-one tons of muck are hauled in the 35-yard Le Tourneau "buggie" mounted on this truck. It rides on a small fortune in rubber—26 tires in all. It takes the world's largest dragline crane, a $175,000 Bucyrus-Monighan, the bucket of which dumps 6 tons at a clip, to load the world's largest dump truck.

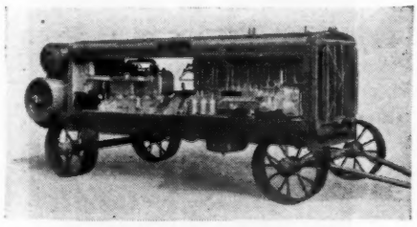


Universal-Lorain Crane used by N. Y. State Highway Department, is mounted on a Four-Wheel-Drive X6 Truck Shown at work at the right.

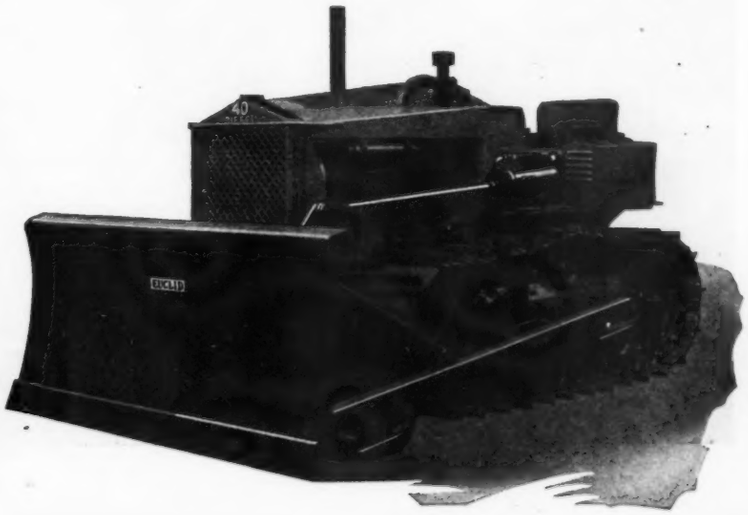


ABOVE: A duplicate position telemeter system for indicating and recording at a distance the position of mechanisms such as gates, valves or water level in water power plants, engine governor positions, bridges or the position of any important mechanism, is announced by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

16 "Caterpillar" Diesels engaged in reclaiming an arid waste at Sacaton, Arizona, for the Pima Indian tribe. The average fuel cost per tractor for a 10-hour day is only 98.9 cents, according to officials of the government's Indian service in charge of the project. The fleet is leveling, ditching and bordering this 50,000-acre tract, preliminary to irrigation.

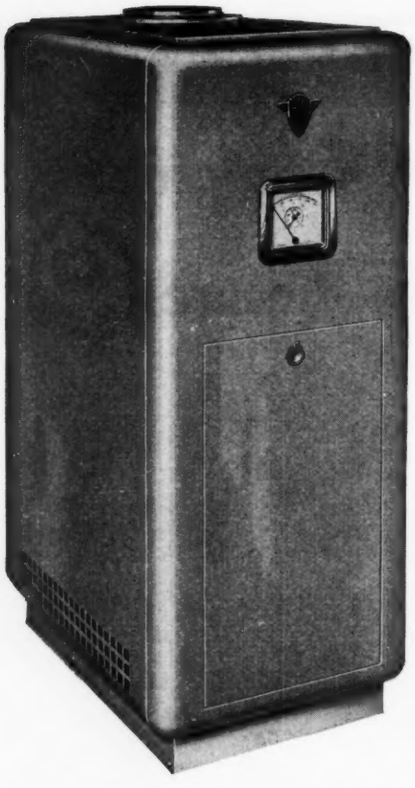


The Schramm 2-stage compressor with caterpillar diesel engine power is shown above. Increased efficiency; any type of mounting; five sizes. Schramm, Inc., West Chester, Pa.



New Bulldozers for Cletrac Diesels

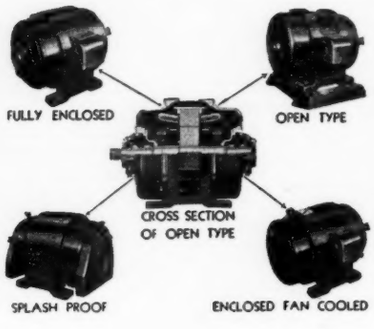
Hydraulically operated Euclid bulldozer, with a high lift, as shown at the right, is announced. For model 25 Cletrac blade is 5' 10" wide and 2' 10" high; for 35 and 40 Cletracs, blade is 6' 6" wide and 3' 3" high. Write "Cletrac" Cleveland, O., or Euclid Rd. Mchry Co., Cleveland, O.

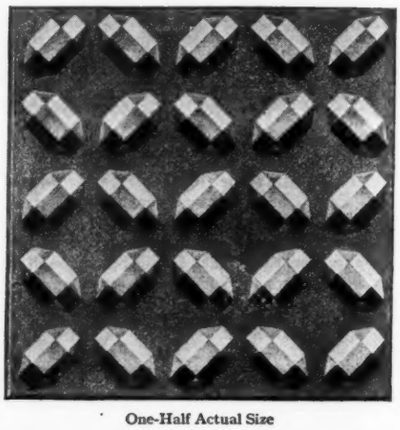


A gas fired boiler for sewage disposal plants is shown above. This is the Empire boiler, put out by the American Gas Products Corp., 40 W. 40th St., N. Y. Available in 37 sizes for all conditions of service and for all sizes of plants. Included in design is a control which automatically shuts off the gas in the event of pump failure.

Watertight, low center of gravity, light weight are features of the 11-yard Trailmobile special trailer shown above. A special vibrator prevents bulk materials from arching. The unit shown above handles bulk cement for the concrete pipe line of the Los Angeles Metropolitan Water District. The Trailer Co. of America, Cincinnati, O.

P & H convertible motors, shown below, are made in sizes from ½ hp, 600 rpm to 125 hp, 3600 rpm. Outstanding feature is convertibility from open type fan cooled, splash proof or totally enclosed construction. Bulletin HM-1 describes them. Harnischfeger Corp., Milwaukee, Wisc.

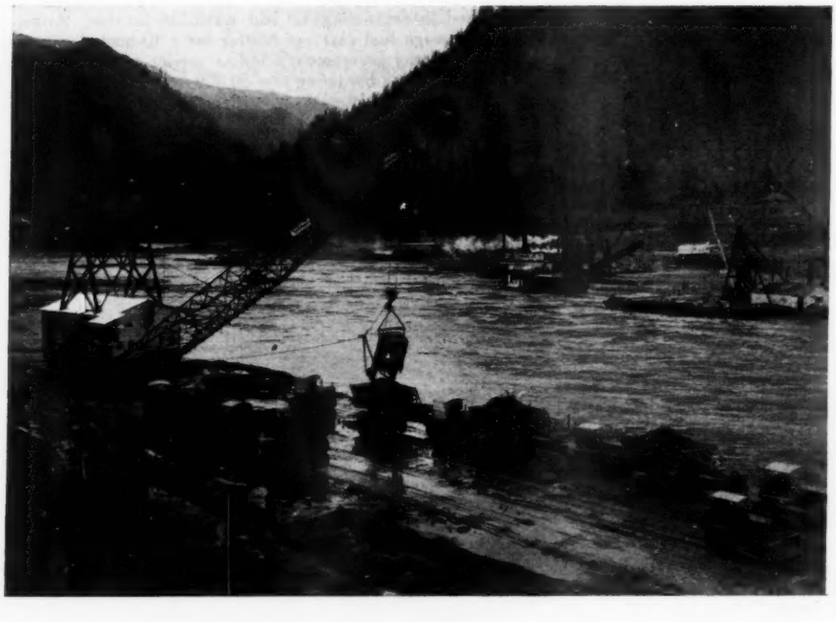


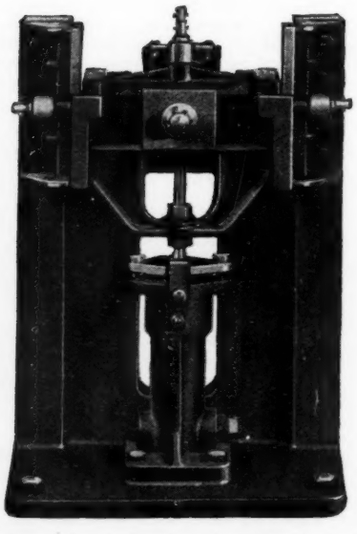


One-Half Actual Size

"Multigrip" floor plate, shown above, has been announced by Illinois Steel Company, Chicago, Ill. The design assures the highest degree of skid resistance from every angle. Gives comfort under foot. May be cleaned readily and drains freely. There are no pockets in which water can accumulate. Its symmetrical design minimizes waste in cutting. Standard weights and sizes on request.

Le Tourneau wagons, equipped with balloon tires and Timken bearings, are shown below on the Bonneville Dam project. Drawn by Caterpillar tractors, these wagons are hauling loads of 20 to 40 cubic yards of saturated gravel over mucky roads without difficulty. The dragline shown is a Bucyrus-Monighan.





Dearborn chemical pump, above, feeds chemicals into water at rates dependent on the rate of water flow. Operation by water power, electric motor, ratchet or reciprocating motion, chain or belt drive. Details from Dearborn Chemical Co., 310 South Michigan Ave., Chicago, Ill. This machine is adapted for any type of liquid or semi-liquid chemicals.

Treatment of Commercial Wastes in Connecticut

IN CONNECTICUT, no sewage treatment plant can be built, extended or replaced until the plans have been approved by the State Water Commission; which approval, that commission believes, "should be based on complete study of local conditions in each individual case, and, further, it should carry assurance to the officials of municipalities that, in the opinion of the engineers of the State, the type of plant decided upon is the best from the point of view of efficiency as well as the most economical to construct and operate, all factors being considered." The Commission's program "contemplates that every Connecticut municipality now discharging untreated domestic sewage to a waterway shall provide itself with a sewage treatment plant."

Research and laboratory work is carried on for the commission by the Hall Laboratory of Chemistry of Wesleyan University. During the two years covered by the biennial report just issued, systematic studies have been carried on in ten industries, to determine the best methods of treating wastes from manufacture of wool felt, candy, cardboard, finishing rabbit skins, manufacture of woolen goods, distilleries, breweries, dairies, electrolytic plating, and boiling off cotton goods.

Wool, Candy, and Cardboard Wastes

The waste from wool felt manufacture is a solution of sulphuric acid containing dye wastes, the acid being the chief objection. The process adopted is to filter and neutralize in a large tank with high-manganesia limestone, followed by separate tanks containing ordinary high-calcium limestone; which satisfactorily neutralizes the acid, recovers the fiber and removes the color.

The candy factory wastes contain sugar syrups and fibrous vegetable materials, disposed of by heating to coagulate the vegetable matter, removing the scum and trickling filter treatment of the effluent.

The cardboard factory discharges pigments, fillers, sizing and paper pulp; treated by mechanical screening, and, when operating on a product of uniform color, recirculating the liquid.

From finishing small animal skins a very putrescible waste is discharged. By neutralizing it with an excess of lime, and removing the solids by sedimentation or filtering a marked improvement is obtained.

Waste from woolen goods manufacture was easily treated, 90% of the objectionable contents being removed from a thousand gallons of waste by 3 or 4 cents worth of chemical coagulant.

Distillery Wastes

Distillery waste is a major problem. Either trickling filter or anaerobic digestion, preceded by screen filtration, reduces the objectionable matter by 90%; the screenings can be sold for cattle food; but evaporation of all the liquid, practiced in other states, effects 100% removal. Beer slop from breweries, being less concentrated, can be treated satisfactorily by trickling filters, which is recommended; the remaining liquid wastes being discharged into the sewer.

For dairy wastes, trickling filters seem to offer the best solution.

Wash waters from electrolytic plating process contain metal salts which can be recovered as valuable by-products, the most toxic and generally objectionable being the soluble cyanides. A simple and fairly satisfactory method of removing these is acidification, followed by storage in tanks or ponds offering large surface areas for vaporization of the hydrocyanic acid. Where such large areas are not available, two processes are suggested: 1—Combined acidification and aeration with flue gas in the power plant stack; 2—Treatment of the waste with iron pickle liquor or added iron salts and sulphuric acid, which preciptates insoluble cyanides such as prussian blue, the residual hydrocyanic acid being driven off by aeration, carrying the vapor off through a stack.

Some Conclusions

Studies of the various treatment processes were made and certain conclusions reached; among them the following: Oxidizing micro-organisms "are destroyed, or their activity much impaired, by the usual constituents of many industrial wastes. Hence, industrial wastes can not be transformed into harmless products by natural oxidation processes as readily as domestic wastes. If, however, it were possible to find stable inorganic oxidation catalysts, such substances might bring about oxidation of the toxic industrial wastes in the same way that micro-organisms act with sanitary wastes. The chief method studied, during an investigation covering a period of eighteen months, was oxidation by means of finely divided air in the presence of a variety of suspended and dissolved catalysts" of "a synthetic waste, containing known amounts of five common constituents of industrial wastes." Aeration of this for 24 hours decreased the organic content 10% in the presence of suspended hydroxides of iron and manganese; 30% in the presence of soluble salts of iron and manganese; and 70% in the presence of large amounts of granular coke, pumice stone, or permutit, impregnated with certain solid catalysts. The last "very encouraging preliminary result will be further investigated."

"Comparisons of the efficiency of ferrous and ferric sulphates as coagulants for textile waste treatments indicate slight advantages on a cost efficiency basis for the ferric compounds. These compounds are also applicable over a wider pH range, but for small installations, minor difficulties, such as increased corrosion of equipment, largely offset these advantages."

Studies made of the possibilities of re-using iron and other coagulating substance in sludge from industrial wastes indicated that "such re-use is not only feasible but that, apparently due to the accumulation of other insoluble materials and the increased concentration of electrolytes, the coagulants obtained by re-dissolving flocs are increasingly efficient for several but not an indefinite number of cycles."

The report of the Hall Laboratory referred to above was signed by Prof. C. R. Hoover. Geo. T. Kimball is chairman of the State Water Commission.

Personal News—Catalogs—Prices

Personals

Louis A. Geupel, who has been chief engineer of the Indiana State Bureau of Sanitary Engineering since May, 1933, has resigned to accept a position with the city of Evansville as city engineer. B. A. Poole, who has been assistant chief engineer for the past several years, has been promoted to the position of chief engineer.

E. M. Fleming, for the past six years manager of the Highways and Municipal Bureau of the Portland Cement Association, Chicago, has been appointed district manager of the New York office.

Black & Veatch, consulting engineers, have moved their offices to 4706 Broadway, "Country Club Plaza," Kansas City, Mo.

Ralph Sweeney has been appointed a sanitary engineer of the Division of Sanitation, New York State Department of Health. Mr. Sweeney was formerly with the Ohio Department of Health, and later with Ohio municipalities in sewage plant design and operation. He is a major, sanitary corps reserve, U. S. Army.

Ray P. Tarbell has been appointed manager of the Welding Division, Ideal Electric & Mfg. Co., Mansfield, Ohio.

Franklin W. Murray has been appointed district manager of the D. W. Haering Co., with offices in the Fisher Bldg., Detroit, Mich.

Paul W. Gregory has been appointed general manager of the Canton Culvert Co., Canton, O., subsidiary of Republic Steel Corp. He succeeds F. A. Kelly, recently appointed president of the Toncan Culvert Mfrs. Ass'n.

H. H. Sweatt, for the past 8 years vice-president and general manager of the Minneapolis-Honeywell Regulator Co., has succeeded M. C. Honeywell as president, the latter becoming chairman of the executive committee.

Safety Signals:

Particular attention must be paid to safety in unemployment work, where many men are unaccustomed to construction. The CWA emphasized this phase, with quite remarkable results. There is pictured herewith a simple and excellent type of safety signal which is particularly fitted for street, road, sewer, water and other municipal and county construction. The type shown is but one of many available, which we do not have space to illustrate. It is composed of a standard onto which various signs may be snapped. The cost of these signals is very low. For a fuller description write for Bulletin 322 to the Martindale Electric Co., 1378 Hird St., Cleveland, Ohio.

An Efficient Safety Signal.

Safety Treads:

A new booklet on rubber bonded safety treads for stairways has been issued by the Norton Co., Worcester, Mass. Installation data and methods make this a handy booklet to have.

Soil Erosion Control:

Terracing for erosion control is discussed in an interesting and instructive manner in the new Austin-Western booklet on the subject. The best methods of the work, profiles, outlets, and other work are covered. Ask for Bulletin 1383, Austin-Western Road Machinery Co., Aurora, Ill.

Diesel Engines:

Considerable material of value on this subject is contained in a 16-page bulletin issued by Worthington Pump & Machinery Corp., Harrison, N. J. Ask for Bulletin S-500-B6D, which covers engines from 25 to 1000 h.p., and from one to eight cylinders.

Feed Water Regulator:

A 16-page bulletin, "Bailey Feed Water Regulators," is being distributed by the Bailey Meter Co., Cleveland, Ohio. Ask for Bulletin No. 83.

Robinson Salt Glazed Vitrified Clay Liner Plates for protection of surfaces against erosion and disintegration from sewage are described and illustrated in a 20 page booklet just issued by the Robinson Clay Products Co., Akron, O.

The Borden Co., Warren, O., manufacturers of pipe tools, have been authorized to change their name to Beaver Pipe Tools, Inc.

The New Jersey Sewage Works Association

The 20th annual meeting of this, the oldest sewage works association (we believe) was, literally speaking, a howling success. It didn't seem just right without John R. Downes, who is traveling in Europe, but under the able management of W. C. Mallalieu, president, the meetings moved smoothly through a program filled with good papers.

The sessions began the forenoon of March 21. Speakers at this meeting included Champlain L. Riley, on spray drying of sewage sludge; Weston Gavett, with a description of the activated sludge plant at Bernardsville, N. J., and J. K. Hoskins, who outlined a program for a national policy of stream cleanliness.

After lunch, Prof. H. N. Lendall gave a progress report on experimental work on sedimentation, E. T. Killam and M. H. Klegerman reported on explosion hazards in sewers, L. L. Hedgepeth discussed the use and abuse of sewage treatment chemicals, and Willem Rudolfs reported on the work at the sewage experiment station.

The annual speechless dinner was the usual success, or maybe more so. There were no set speeches, but there was a lot of talk among the various groups, and occasionally a little action. Some homemade songs were sung which made quite a hit with many of the operators.

Thursday afternoon and Friday the Oliver Filter demonstrations out at the sewage treatment plant showed a quick and satisfactory method of dewatering sludge. A small model was operated with complete success.

After the business meeting on the morning of the 22nd, LeRoy Forman reported on the trickling filter survey in the state, and W. A. Darby summarized trends in sewage treatment and gave cost data. Morris Cohn spoke on combined sewage and garbage disposal in the afternoon and W. H. Baumgartner reported on experimental work in coagulation and sedimentation using iron salts.

American Water Works Association:

The annual meeting of this association will be held at the Netherlands-Plaza Hotel, Cincinnati, O., May 6 to 10. As usual, there will be a very complete program for the technical man, covering all phases of waterworks construction, design and operation, and the social phases of the meeting will also be excellent. A more complete program will be available later. In the meantime, plan to be in Cincinnati for the convention.

Material Prices

(Published for information only)

(March 21, 1935)

Warehouse Prices on Reinforcing Steel and Structural Shapes

	Structural Shapes	*New Billet Reinforcing Bars*
New York	3.37c	2.82
Boston	3.52	—
St. Louis	3.44	—
Cincinnati	3.40	3.25
Pittsburgh	3.15	2.90
Chicago	3.20	—
Philadelphia	2.95	2.955
Cleveland	3.31	2.60
San Francisco	3.55	3.50

Prices on cast iron pipe, net per ton, Class B, 6-inch and larger, AWWA specifications*

Boston	$47.50	Baltimore	$45.50
New York	44.90	Atlanta	42.00
Chicago	46.00	Birmingham	38.00
Minneapolis	48.50	Kansas City	48.15

Burlington, N. J., $42.00; extra price for 4-inch, $3.00 per ton; extra for Class A, $3.00 per ton

**Information, courtesy U. S. Pipe & Foundry Co.*

Warehouse Prices on American Pig Lead

Per pound

New York	4.50 to 5.50
Cleveland	4.50 to 4.75

MUD-JACK METHOD

Corrects Sunken Street Slab—

as well as curb, gutter and walks. The No. 10 N. E. C. Mud-Jack raises sunken curb and gutter to the original or proper grade — and then raises the street slab to obtain a level surface. No replacement cost necessary—no street obstruction common to reconstruction activities—and above all, maintenance costs are reduced to a minimum.

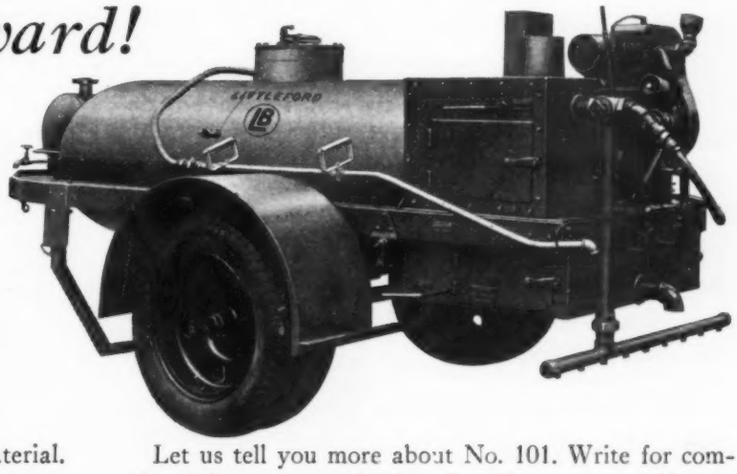
Write for Mud-Jack Bulletin

KOEHRING COMPANY

Milwaukee Wisconsin

For Raising Concrete Curb, Gutter, Walks, Street

MAINTENANCE EQUIPMENT *takes a Step Forward!*



Save on cost of bituminous material—use No. 101 and you stop paying package prices. Save on handling—take material to the job in No. 101 ready for application. No longer will you have to load a truck with drums to be distributed along the roadside.

The No. 101 Utility Spray Tank is our latest contribution to the highway industry. It is made in capacities from 300 to 800 gallons—mounted on two or four wheeled running gear. It has an air-cooled engine, Viking pump, heat flues and oil burners—handles any kind of bituminous material.

The No. 101 may be fitted with as many Hand Spray Attachments as your crew can efficiently use—spray is individually controlled from the Spray Handle. The four foot spray bar is merely supplementary but comes in mighty handy where light oiling is called for and on large skin patching jobs.

Let us tell you more about No. 101. Write for complete information and prices. It will cost you nothing to learn all about this remarkable, low-cost maintenance unit.

THE SIGN OF A GOOD HEATER LB LITTLEFORD BROS. CINCINNATI, OHIO

LITTLEFORD

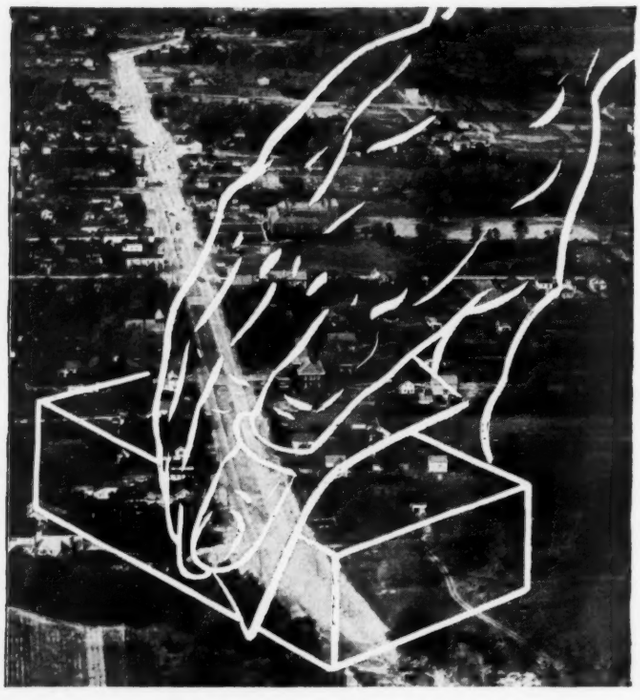
Road Maintenance Equipment

SINCE 1900

LITTLEFORD BROS. 452 E. PEARL ST. CINCINNATI, O.

Have you looked over the booklets described on pages 47, 48 and 52?

PROTECTION FROM WEATHER DAMAGE



Damage due to the effects of weather is the outstanding cause of pavement failure.

You probably have seen that proved on some unprotected pavement that went to pieces carrying little or no traffic. Weather destroyed it.

A brick surface is the best way to prevent destruction by weather. It seals the base from water and its destructive action. Freezing and thawing are eliminated as dangers to pavement life. The vitrified wearing surface is an armor that cannot be pierced. The flaws and weaknesses that otherwise cause traffic to pound and hammer are not allowed to develop.

For recommendations on resurfacing various types of pavements with brick, write National Paving Brick Association (Affiliated with Structural Clay Products, Inc.) **1245 National Press Building, Washington, D. C.**

BRICK

HAS LEAST YEARLY COST

When writing, we will appreciate your mentioning PUBLIC WORKS.

Comparative Cost and Efficiency of Coagulants

SASKATOON, CANADA, with a population of 45,000, has a municipal water supply which is treated by coagulation, sedimentation and chlorination. The average annual consumption is 3 m.g.d., the maximum day 5.3 m.g.d. and the maximum hour 8 m.g.d., which last is the capacity of the filters. The total alkalinity of the river water varies from 100 p.p.m. during flood periods to 250 p.p.m. during low water winter conditions. The pH varies from 7.6 to 8.5, but fell below 8.0 only a few times in 1934. Turbidities varied from 10 p.p.m. in winter to 8,000 p.p.m. during the June floods.

A general survey of the efficiency of the water purification plant was started in 1933, in connection with which tests have been run to determine the desirability of making changes in certain details of operation. Some of the results of these tests are given briefly below.

Using aluminum sulphate in conjunction with sodium sulphate, sodium aluminate, etc., some reduction in the aluminum sulphate dose was possible, but not sufficient to offset the cost of the second chemical. Also pH adjustment did not increase the efficiency of the alum sufficiently to compensate for the added cost.

The coagulants had been measured and fed with solution type equipment, but it was found impossible to feed a pre-determined dosage of chemical with anything approaching precision, as a result of which more chemical was fed than necessary. After considering various types of equipment, orifice feed boxes of the Roberts Filter Co., type CSD, were installed in March, 1934, at a cost of $900 and have given good satisfaction; and it is estimated that their use will effect an annual saving of $300, or about 10% of the former cost of aluminum sulphate.

Tests of various coagulants made in 1934 showed that use of ferrous sulphate and lime would be 40% to 50% cheaper than aluminum sulphate. (During these tests the river water was lower in turbidity than usual.) The costs on which this comparison was based were: Aluminum sulphate, $2.52 per 100 lbs.; ferrous sulphate, $1.78 per 100 lbs.; lime, $1.27 per 100 lbs.; all delivered at the water works plant.

The quality of the final effluent is excellent with the use of either aluminum sulphate or ferrous sulphate and lime. Change from one to the other effects no change in the length of filter run or in the amount of wash water required. With all raw water conditions so far encountered, ferrous sulphate coagulates with maximum efficiency when the pH of the treated water is maintained at 8.5.

In referring to these conclusions, B. P. Scull, development engineer, city engineers office of Saskatoon, says: "It is recognized that a general conclusion cannot definitely be drawn if based on operations covering one year only, so these figures are tentative and subject to alterations as more information is obtained. Although ferrous sulphate will be used in 1935 as the coagulating chemical, sufficient plant-size tests will be made using aluminum sulphate to either confirm the result of operation for the year 1934 or to show the effect of any raw water conditions not encountered during that period."

The above is condensed from an article in "The Canadian Engineer" by Mr. Scull, who was in direct charge of the investigations, under the general supervision of G. D. Archibald, city engineer.